UNIVERSITY OF CALIFORNIA PUBLICATIONS

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

COLD STORAGE AS AN AID TO THE MARKETING OF PLUMS

A PROGRESS REPORT

BY

E. L. OVERHOLSER

BULLETIN No. 344
JUNE, 1922

UNIVERSITY OF CALIFORNIA PRESS
BERKELEY
1922

David P. Barrows, President of the University.

EXPERIMENT STATION STAFF

HEADS OF DIVISIONS

Thomas Forsyth Hunt, Dean.
Edward J. Wickson, Horticulture (Emeritus).
——— ———, Director of Resident Instruction.
C. M. Haring, Veterinary Science, Director of Agricultural Experiment Station.
B. H. Crocheron, Director of Agricultural Extension.
H. J. Webber, Citriculture, Dean and Director of Citrus Experiment Station.
James T. Barrett, Plant Pathology, Acting Director of the Citrus Experiment Station.
C. B. Hutchinson, Plant Breeding, Director of the Branch of Agriculture.
Hubert E. Van Norman, Dairy Management.
William A. Setchell, Botany.
Myer E. Jaffa, Nutrition.
Ralph E. Smith, Plant Pathology.
John W. Gilmore, Agronomy.
Charles F. Shaw, Soil Technology.
John W. Gregg, Landscape Gardening and Floriculture.
Frederic T. Bioletti, Viticulture and Fruit Products.
Warren T. Clarke, Agricultural Extension.
Ernest B. Babcock, Genetics.
Gordon H. True, Animal Husbandry.
James T. Barrett, Plant Pathology.
Walter Mulford, Forestry.
Fritz W. Woll, Animal Nutrition.
W. P. Kelley, Agricultural Chemistry.
H. J. Quayle, Entomology.
Elwood Mead, Rural Institutions.
H. S. Reed, Plant Physiology.
L. D. Batchelor, Orchard Management.
J. C. Whitten, Pomology.
†Frank Adams, Irrigation Investigations.
C. L. Roadhouse, Dairy Industry.
R. L. Adams, Farm Management.
W. B. Herms, Entomology and Parasitology.
F. L. Griffin, Agricultural Education.
John E. Dougherty, Poultry Husbandry.
D. R. Hoagland, Plant Nutrition.
G. H. Hart, Veterinary Science.
L. J. Fletcher, Agricultural Engineering.
Edwin C. Voorhies, Assistant to the Dean.

DIVISION OF POMOLOGY

J. C. Whitten
W. L. Howard
W. P. Tufts
E. L. Overholser
A. H. Hendrickson
F. W. Allen
G. L. Philp
J. P. Bennett
F. E. Neer
W. P. Duruz
L. C. Barnard
C. L. Austin
L. H. Day
E. M. Russ

---

† In coöperation with Office of Public Roads and Rural Engineering, U. S. Department of Agriculture.

COLD STORAGE AS AN AID TO THE MARKETING OF PLUMS

A PROGRESS REPORT

By E. L. OVERHOLSER

CONTENTS

PAGE
Cold storage of plums ... 427
  Objects ... 427
Extent of the plum industry in California ... 428
  Varieties of plums grown ... 429
Nature of the investigation ... 431
  Fruit ripening ... 431
  Respiration numbers ... 431
  Effect of temperature on respiration ... 431
  Methods of procedure ... 432
  Definition of terms ... 433
Experiment data ... 434
  Relative time of keeping ... 434
  Type of failure in storage ... 450
  Temperature of storage for plums ... 450
  Degree of maturity for picking ... 451
Practical application of results ... 454
  Storage of early plums ... 457
  Storage of late plums ... 458
  Precautions necessary previous to storage ... 460
Acknowledgements ... 460
Summary and conclusions ... 461
Bibliography ... 463

COLD STORAGE OF PLUMS

The plum has not been regarded, heretofore, as a cold storage fruit. At most it has been stored only a few days to avoid a temporary glut of the market. The investigations reported herewith, however, indicate that certain varieties of California plums can be held in storage for optimum periods of about six to twelve weeks and after removal from storage will hold up in good dessert condition for an ample period to admit of handling on the market.

Objects.—The purpose of placing fruit in cold storage is to prolong the time during which it remains in good condition. This is accomplished (1) by retarding the ripening processes which continue after the fruit is harvested, and (2) by preventing or retarding the development of decay organisms. Thus cold storage extends the time for marketing, helps to avoid the glutting of markets, and decreases the amount of spoiling.

EXTENT OF THE PLUM INDUSTRY IN CALIFORNIA

The value of data concerning the cold storage of California plums can be emphasized by considering the status of the industry in this state. The rapid development of plum and prune growing is shown in Table I, compiled from the 14th Census of the United States.

TABLE I

NUMBER OF BEARING AND NON-BEARING PLUM AND PRUNE TREES AND THE PRODUCTION IN BUSHELS FOR THE PRINCIPAL COUNTIES OF CALIFORNIA (1919)

County	Trees in bearing	Trees not of bearing age	Production in bushels
Entire state	8,767,436	5,237,145	13,200,805
Santa Clara	3,371,436	1,354,155	5,615,344
Sonoma	877,983	854,411	1,436,718
Solano	609,755	162,160	803,495
Tulare	422,228	269,009	703,554
Napa	344,411	449,866	530,455
Placer	243,132	703,593	495,574
Butte	268,270	196,164	391,735
Sacramento	233,237	132,600	389,406
Sutter	159,002	319,609	277,427
San Benito	145,311	154,322	152,009
Colusa	101,709	134,670	372,314
Fresno	109,141	120,963	202,067
Santa Cruz	103,154	36,647	101,983
San Joaquin	94,222	111,875	168,201
Yolo	93,541	112,329	152,485
Alameda	145,114	50,182	123,652

The number of non-bearing trees nearly equals the number of bearing trees. This indicates a doubling of the quantity produced in the near future. The growth of the shipping-plum industry of California is shown by the number of cars shipped to eastern markets* during recent years, viz:

1910, 1,552 cars	1918, 2,483 cars
1914, 1,907 cars	1920, 2,534 cars

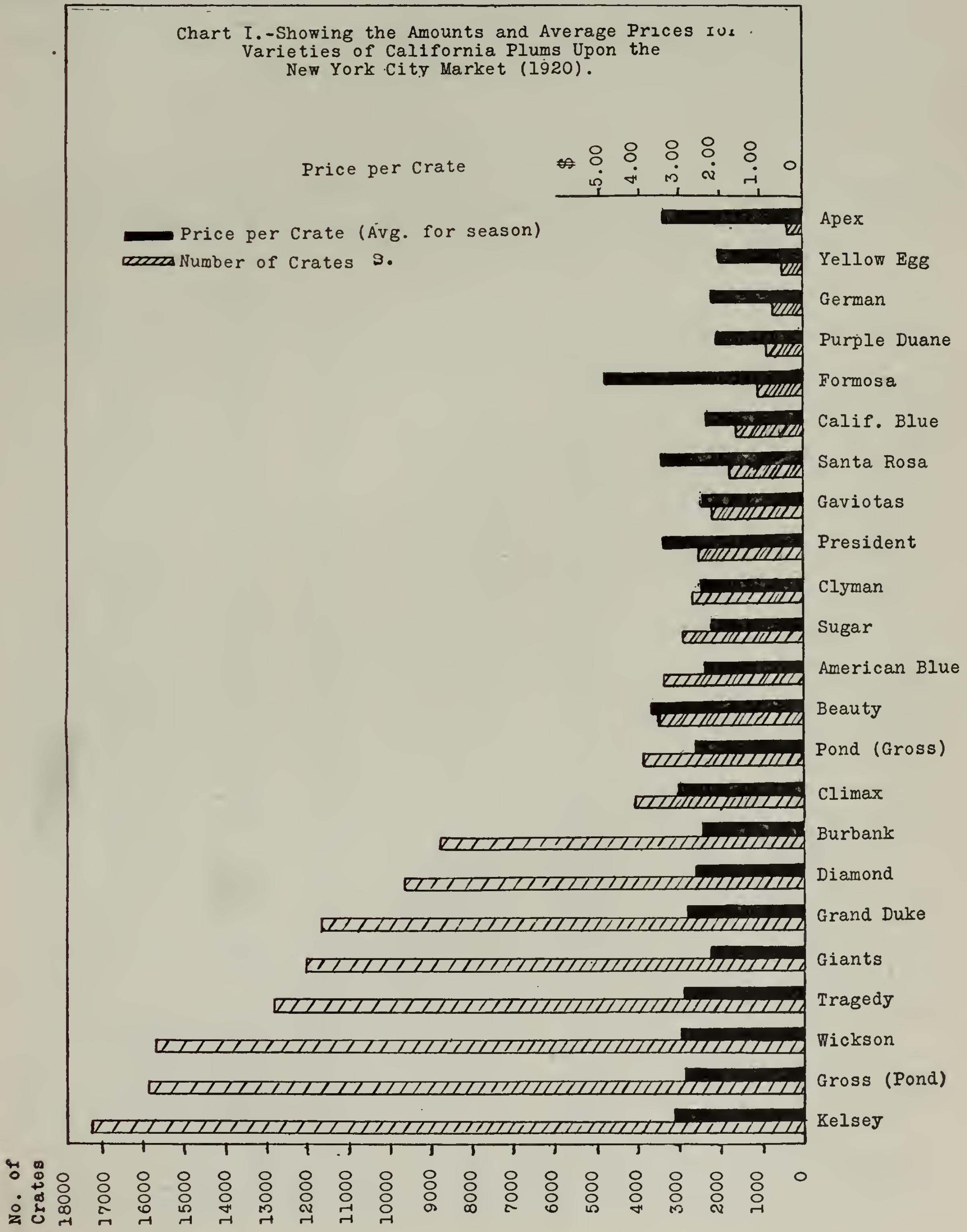
The principal districts in California from which fresh plums are shipped are Vacaville, Winters, points along the Sacramento and American rivers, Loomis, Penryn, Newcastle, Lincoln, Auburn, Colfax, Suisun, and points in the San Joaquin and Santa Clara valleys.

Placer County leads in acreage devoted to growing plums for fresh fruit. This county had about 6500 acres in bearing in 1918. Solano County ranked second, with an acreage of about 2500 devoted to growing shipping plums. Acreages in the Santa Clara Valley and along the Sacramento and American rivers in Sacramento County amount to a little over 1500 acres in each of these districts. The production of fresh plums is relatively high, from 1200 to 2000 tons a year each, in San Joaquin, Yolo, Los Angeles, and Tulare counties. A few plums are grown in practically every county in the state and development on a much larger scale is possible.

---

* California Fruit News, 1920.

Varieties of plums grown.—In California, plums are divided into two groups: (1) varieties which are shipped fresh and which usually



do not contain enough sugar for drying purposes, known as "plums," and (2) varieties which dry well, known as "prunes." Prunes are seldom consumed in the fresh state, although some of them are excellent dessert fruits.

The varieties grown as shipping plums, their present relative importance, and the prices received are shown by Table II, and Chart I. The varieties in Table II are arranged approximately in their order of ripening. The high prices paid for Formosa, Apex, and Beauty were due not so much to the small amount of each variety shipped as to the fact that they were the first varieties to reach the market. The variation in price indicates that storage even for a short time, to relieve glutted markets, may yield a profit.

TABLE II

The Highest and Lowest New York Prices and the Dates on which Paid, the Average Price, Length of Shipping Season, and Number of Crates Received, for 23 Varieties of California Plums (1920)

Variety	Date	Highest Price	Date	Lowest Price	Average price for season	Total crates received	Length of shipping season, days
Formosa	June 11	$6.25	June 22	$3.75	$4.90	1,040	18
Apex	June 15	5.06	June 17	2.50	3.43	274	8
Beauty	June 11	6.00	June 20	1.55	3.73	3,660	40
Clyman	July 5	3.25	June 23	2.13	2.59	2,690	14
Climax	June 25	4.00	July 23	1.82½	3.05	4,155	36
Santa Rosa	June 28	4.25	July 20	2.02½	3.42	1,855	28
Tragedy	June 28	3.93½	July 23	1.91	2.75	12,890	37
California Blues	July 27	2.87½	July 23	1.75	2.38	1,615	13
Gaviotas	July 28	2.81½	July 23	2.25	2.51	2,140	11
Purple Duane	July 27	2.62½	July 23	1.75	2.10	875	12
Burbank	July 20	2.27½	Aug. 4	1.75	2.12	8,750	15
Wickson	July 20	3.37½	July 23	2.47½	2.92	16,055	24
Diamond	July 29	3.07½	Aug. 18	1.87½	2.40	9,650	32
Kelsey	Sept. 17	5.37½	Sept. 8	2.00	3.18	17,350	52
Grand Duke	Aug. 3	3.22	*	2.25	2.62	11,620	55
American Blues	Aug. 4	2.80	Aug. 17	2.01	2.47	3,585	19
Sugar	Aug. 5	2.62½	Aug. 12	1.75	2.21	2,810	20
German	Aug. 4	2.62½	Aug. 10	1.85	2.20	835	8
Hungarian†	Aug. 5	3.07	Aug. 12	1.87½	2.54	3,840	42
Yellow Egg	Aug. 11	2.45	Aug. 19	1.32½	2.03	415	21
Gross†	Aug. 5-Sept. 2	3.25	Sept. 20	1.93	2.76	16,125	47
Giants	Aug. 11	2.46	Sept. 13	1.25	2.12	12,010	35
Presidents	Aug. 12	4.12½	Aug. 25	2.44	3.35	2,415	28

---

* Aug. 25, Sept. 3, Sept. 15.

† Synonyms for Pond, which is the correct name for the variety.

NATURE OF THE INVESTIGATION

To make clear the nature of the problem, the method of procedure, and the data obtained, a brief discussion of the factors involved in the ripening of fruit is presented.

Fruit Ripening.—Bigelow, Gore, and Howard[1] have determined that the chemical changes undergone by fruits during the ripening process relate primarily to (*a*) carbohydrates; (*b*) acids.

Respiration numbers.—The disintegration of carbohydrates and acids as a result of respiration and other metabolic activities involves the production of carbon dioxide. It is therefore of interest to measure the output of carbon dioxide and to correlate it with the state of ripening. Gore[3] has suggested that the amount of carbon dioxide evolved by a unit weight in a unit time may be taken as a measure of ripening velocity. This value, or "respiration number," as determined by Gore for several fruits, is shown in Table III.

TABLE III

RESPIRATION NUMBERS OF CERTAIN FRUITS AS AN INDICATION OF THE RAPIDITY WITH WHICH THEY RIPEN

Species	Variety	Respiration number (at 0° C. in milligrams, per kilogram)
Blackberry	El Dorado	30.9
Strawberry	Gandy	17.8
Plum (*P. americana*)	Wragg	6.5
Apple	Missouri Pippin	4.6
Orange	Valencia	1.8

Table III shows that the respiration number is very variable for the different fruits. The soft fruits, like the blackberry and strawberry, have the highest value. The plum has a value only slightly higher than the apple, and the citrus fruits stand lowest of all. The higher the respiration number, the quicker the ripening process, and the shorter the time the fruit can be kept. This indicates that plums might be kept in cold storage for comparatively long periods of time if the respiration number as determined by Gore is applicable.

The effect of temperature on respiration.—Gore[3] carried on his experiments at various temperatures and found that the relation between temperature and respiration agreed very closely with Van Hoff's law, i.e., the maturation velocity at 8° C. is double that at 0° C., and at 16° C. four times that at 0° C. This agrees with the results obtained by Buison.[2]

Hawkins and Sando[4] have shown with strawberries, black and red raspberries, and cherries that cooling the fruit renders the epidermis more resistant to mechanical injury and therefore supposedly less likely to infection by fungi or bacteria. These workers advance as a possible explanation of the phenomenon that the surface of the fruit might be covered with a wax which softened at the higher temperatures and became harder and more resistant when cooled. Another explanation is that the walls of the external cells of the fruits have a lower coefficient of expansion than their contents. At the higher temperatures this would result in the walls being under a greater strain and they would therefore puncture more easily than at a lower temperature.

It must not be forgotten that chemical and physiological changes occur even at the lower temperatures. Cooling causes a retardation, not a complete cessation of the processes. There is also evidence that temperatures near 30° F. may result in a disturbance of the normal metabolic or enzymatic processes.

Methods of procedure.—The investigation was begun in the summer of 1918 by R. H. Taylor,* assisted by the writer, and was carried on through 1919 and 1921.

The fruit was harvested and packed in baskets of five-pound capacity at the University Farm, Davis. It was then shipped immediately by express to the Experiment Station, Berkeley, and at once placed in cold storage. As a rule, not over forty-eight hours elapsed from the time of picking until placement in cold storage.

From four to twelve five-pound baskets of each variety were included in the tests. When first received, the degree of ripeness, the color, and the condition of the fruit were carefully noted. About two dozen specimens were taken from the baskets and permitted to ripen at room temperature. This was done to determine the length of time the fruit would keep, and to see how it would behave, without cooling.

At intervals of about a week or ten days, fifteen or twenty additional specimens were removed from cold storage and kept at room temperatures of 68° to 74° F. to ripen. While ripening, the plums were kept on cardboard plates in dark, ventilated lockers.

Each lot of fruit was observed at intervals of two to four days after removal to room temperature. At each observation the following points were noted: (*a*) general condition; (*b*) degree of ripeness; (*c*) juiciness and texture; (*d*) flavor and quality, and (*e*) amount of wilting and rotting.

The chief preliminary points determined were as follows: (*a*) the relative retention of quality of the various varieties in cold storage;

---

* Professor Taylor resigned July 1, 1919.

(*b*) which varieties kept longest in cold storage; (*c*) the influence of the time of harvesting and the inherent qualities of the varieties on the time of keeping; (*d*) the optimum storage period; (*e*) the maximum storage period; (*f*) which offer the most promise as storage varieties when the above points together with their attractiveness, color, size, quality, and flavor are considered; (*g*) the best temperature for storage; and (*h*) the best stage of maturity at which to pick the fruit for storage.

Definition of terms.

Optimum storage period refers to the latest time of removal which would give the best results regarding quality and time of holding up after removal from cold storage.

Maximum storage period refers to the time beyond which it would be unsafe to keep the fruit in storage though it may be still in good condition, because of the likelihood of loss of quality, softening of texture, susceptibility to rot organisms, tendency to wilting, and rapidity of breakdown after removal.

Degrees of ripeness.—The different 'degrees of ripeness' were described by using the following terms:

1. Hard unripe
2. Firm unripe
3. Firm ripe
4. Medium firm ripe
5. Medium ripe
6. Medium soft ripe
7. Soft ripe
8. Past ripe
9. Rotten

Color.—The different shades of ground 'color' of the fruit were described by the following terms, those generally applicable to the most immature fruits being listed first:

1. Green
2. Greenish
3. Whitish green
4. Yellowish green
5. Greenish yellow
6. Yellowish
7. Yellow
8. Brownish
9. Brown

Texture.—The relative juiciness of the plums was described by the following terms:

1. Unusually juicy
2. Very juicy
3. Juicy
4. Moderately juicy
5. Rather dry

Quality.—The 'quality' or pleasantness of flavor of the fruit was described by the following terms:

1. Excellent
2. Very good
3. Good to very good
4. Good
5. Good to fair
6. Fair
7. Poor
8. Very poor

EXPERIMENT DATA

The behavior of each variety in cold storage is shown by the data obtained during the years 1918, 1919, and 1920, summarized in Tables IV to VI and further brought out by Charts II to VI inclusive. Since the data for each year agree very closely, only those for 1920 are given separately.

To assist in drawing conclusions regarding the desirability of a variety for storage purposes, in addition to its behavior in cold storage, notes were made upon the size, color, form, texture, quality, etc. These data are summarized in Table VII.

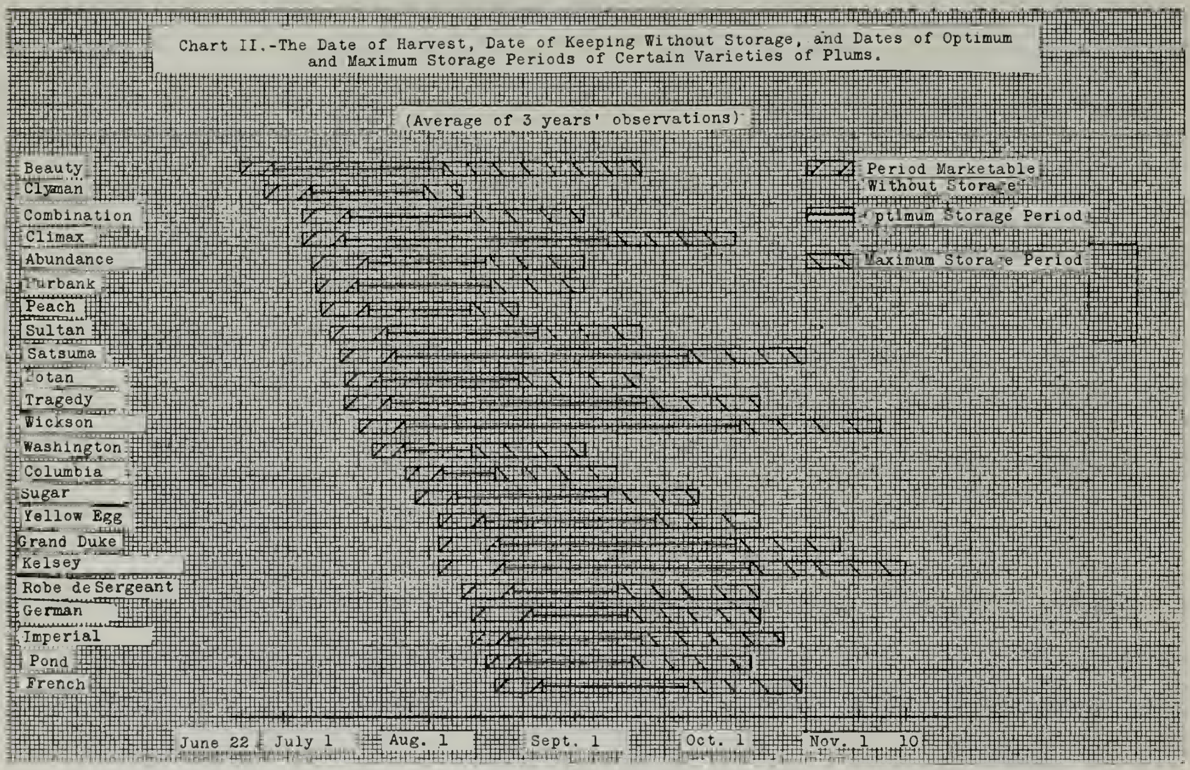


Chart II.-The Date of Harvest, Date of Keeping Without Storage, and Dates of Optimum and Maximum Storage Periods of Certain Varieties of Plums.

(Average of 3 years' observations)

The columns referring to the condition of the fruit at the various periods include the state of maturity or ripeness, as indicated by either degree of firmness of the flesh or color of the skin, and also by the quality attained during the period of marketability following receipt or removal from storage.

Relative time of keeping.

(1) *The best keeping plums.*—The varieties which kept latest in the season and most satisfactorily in cold storage were Kelsey, Grand Duke, and Wickson. At a temperature of 32° F. these varieties kept well until the middle of October, and upon removal from storage remained marketable for a period of from six to twelve days. (Tables IV and VI.)

TABLE IV

TABULATED DATA FOR COLD STORAGE OF PLUMS AT 32° F. FOR 1920

The varieties are arranged in order of their optimum storage dates, those keeping latest being listed first.

Variety	1st, 2d, or 3d Picking	Date Picked	Date Stored	Condition of Fruit upon Entering Storage	Days Kept Without Storage	Opt. Storage Date	Condition of Fruit at Optimum Storage Date	Days Markt. after Removal O. S. Date	Max. Storage Date	Condition of Fruit at Maximum Storage Date	Days Markt. after Removal at M. S. Date	Date of Failure in Storage	Condition of Failure in Storage
Kelsey (X)	1st	July 19	July 20	Hard, green	16	Sept. 27 Oct. 15	Hard, green	4–9	Nov. 8–26	Hard, green, poor quality. Flesh soon browned	3–4	Dec. 30	Rotting. Little flesh browning
Kelsey (X)	2d	Aug. 3	Aug. 4	Hard, yellow green	14	Oct. 15	Hard, ripened to fair quality	7	Nov. 8–26	Hard, green, poor qual. Flesh soon browned	3–4	Dec. 30	Rotting. Little flesh browning
Wickson (X)	1st	July 11	July 13	Green, ripened to poor quality	10	Sept. 27 Oct. 15	Green, ripened to poor quality	7–12	Nov. 8	Quality very poor	7	Dec. 10	Internal flesh breakdown
Wickson (X)	2d	July 11	July 13	Green, ripened to fair quality	10	Sept. 27 Oct. 15	Hard, ripened to fair quality	7–12	Nov. 8	Hard, yellow green. Ripened to fair quality	4	Dec. 10	Internal flesh breakdown
Wickson (X)	3d	July 19	July 20	Green, ripened to good quality	4	Sept. 27	Hard, ripened to very good quality	6	Oct. 15	Firm, ripened to fair quality	4	Dec. 10	Internal flesh breakdown
Satsuma (X)	1st	July 11	July 13	Green, red tinge	12	Sept. 27 Oct. 15	Hard, red-green ripened to fair quality	7	Nov. 8	Hard, red. Quality poor	4	Dec. 30	Wilted and rotting
Satsuma (X)	2d	July 11	July 13	Hard, red-green color	12	Sept. 27	Firm, light red, ripened to fair quality	6	Oct. 15	Firm, light red. Quality poor to fair	4–6	Dec. 30	Rotting

(X)—Indicates: Picked too green. (XX)—Indicates: Pits split.

TABLE IV—(*Continued*)

Variety	1st, 2d, or 3d Picking	Date Picked	Date Stored	Condition of Fruit upon Entering Storage	Days Kept Without Storage	Opt. Storage Date	Condition of Fruit at Optimum Storage Date	Days Markt. after Removal O. S. Date	Max. Storage Date	Condition of Fruit at Maximum Storage Date	Days Markt. after Removal at M. S. Date	Date of Failure in Storage	Condition of Failure in Storage
Satsuma (X)	3d	July 11	July 13	Firm, green-red color	12	Sept. 3 Sept. 15	Firm, red, ripened to very good quality	10	Oct. 15	Medium ripe. Quality fair	7	Dec. 30	Rotting
Agen (French) (X)	1st	July 23	July 24	Very green	11	Sept. 3	Green. Very poor quality	3	Sept. 27	Green, very poor quality	3	Nov. 26	50% rotten
Agen (French) (X)	2d	Aug. 10	Aug. 11	Green, purple-red color	7	Sept. 27	Hard, ripened to poor quality	6	Oct. 15	Medium ripe, poor quality	4	Dec. 1	Rotting
Grand Duke (X)	1st	July 23	July 24	Green, light purple color	14	Sept. 27	Firm, ripened to fair quality	3–6	Oct. 15	Medium ripe, ripened to poor quality	3	Dec. 10	Shrivelled, 20% rotten
Grand Duke (X)	1st	July 23	July 24	Green, purple-red color	14	Sept. 3	Firm, ripened to fair quality	7	Sept. 27	Medium ripe, ripened to fair quality	3	Dec. 10	20% rotten
Grand Duke (X)	2d	Aug. 3	Aug. 4	Firm, green-purple color	11	Sept. 3	Firm, ripened to fair quality	7	Sept. 27	Medium ripe, ripened to fair quality	3–5	Dec. 1	50% rotten
Imperial	1st	Aug. 5	Aug. 6	Hard, purple-green color	5	Sept. 27	Firm, ripened to sweet prune flavor	3–5	Oct. 15	Medium to soft. Fair quality	3	Nov. 29	Flesh brown, 50% rotten
Tragdey (X)	1st	June 30	July 2	Green, purple color	13	Sept. 27	Soft, ripe, excellent quality	6	Oct. 15	Very soft, excellent flavor	3–6	Nov. 29	Overripe, rotting
Tragedy (XX)	1st	June 30	July 2	Green, purple color	13	Sept. 6	Soft, ripe, excellent quality	6	Sept. 27	Very soft, excellent flavor	3–6	Nov. 29	Overripe, rotting
Tragedy (XX)	2d	July 11	July 13	Firm, purple, very little flavor	10	Sept. 3	Medium to soft ripe. Best quality	10	Oct. 15	Very soft, excellent flavor	3	Nov. 29	Overripe, rotting

Tragedy (XX)	3d	July 11	July 13	Medium ripe, purple. Fair flavor	10	Sept. 3	Medium to soft ripe Best quality	10	Sept. 27	Very soft. Excellent flavor	3–5	Nov. 29	Overripe, rotting
Yellow Egg	1st	July 23	July 24	Green	11	Sept. 3	Medium ripe. Fair quality	3–5	Sept. 27	Medium ripe. Fair quality	3	Nov. 26	50% rotten
Yellow Egg	2d	July 28	July 29	Green	9	Sept. 3	Firm, ripened to excellent quality	7	Sept. 27 Oct. 15	Medium ripe. Good quality	3–6	Dec. 10	Too soft, and 25% rotten
Yellow Egg	3d	Aug. 3	Aug. 4	Firm, green-yellow color	5	Sept. 3	Medium ripe. Excellent quality	10	Oct. 15	Soft, fair, quality, but flavor old	3	Nov. 26	30% rotten
Pond (X)	1st	July 23	July 24	Hard, green, red color	8	Sept. 3	Firm, poor quality	3	Sept. 3	Firm. Quality very poor	3	Nov. 15	Internal flesh breakdown
Pond (X)	1st	July 28	July 29	Hard, green, red color	12	Sept. 3	Firm, poor quality	3	Sept. 3	Firm. Quality very poor	3	Nov. 6	Internal flesh breakdown
Pond	2d	Aug. 3	Aug. 4	Firm, purple-red. Fair quality	10	Sept. 3	Firm, ripe. Fair quality	3–5	Sept. 27	Firm ripe. Fair quality	2–3	Nov. 8	Internal flesh breakdown
Pond	3d	Aug. 10	Aug. 11	Soft, flavor sweet and good	7	Sept. 3	Soft, good flavor	3	Sept. 27	Soft, fair quality	3	Nov. 26	Overripe, rotting
German (X)	1st	July 28	July 29	Very green	7	Sept. 3	Green. Very poor	6	Sept. 27	Green. Very poor quality	3	Nov. 26	Badly shrivelled. 50% rotten
German (X)	1st	Aug. 10	Aug. 11	Firm, purple color	7	Sept. 3	Firm, ripened to poor quality	7	Sept. 27	Medium ripe. Poor quality	3–5	Nov. 26	50% rotting
Robe de Sergeant	1st	July 23	July 24	Hard, green, purple color	11	Sept. 3	Firm, ripened to fair quality	3–5	Sept. 27	Soft, fair quality	3	Oct. 22	Overripe and rotting
Robe de Sergeant	2d	July 28	July 29	Firm, purple color	9	Sept. 3	Firm, ripened to good quality	7	Sept. 27	Soft, fair quality	3	Oct. 22	Overripe and rotting
Climax	1st	June 22	June 24	Hard, red tinge	9	Sept. 3	Hard, ripened to fair quality	3–5	Oct. 15	Soft, poor quality. Flavor old	3	Dec. 1	Badly shrivelled. Few rotting
Climax	2d	July 2	July 4	Firm, red tinge	9	Aug. 15	Firm, ripened to excellent quality	6	Sept. 27	Medium ripe. Flavor old	3	Dec. 1	Badly shrivelled. 30% rotten

(X)—Indicates: Picked too green. (XX)—Indicates: Pits split.

TABLE IV—(*Continued*)

Variety	1st, 2d, or 3d Picking	Date Picked	Date Stored	Condition of Fruit upon Entering Storage	Days Kept Without Storage	Opt. Storage Date	Condition of Fruit at Optimum Storage Date	Days Markt. after Removal O. S. Date	Max. Storage Date	Condition of Fruit at Maximum Storage Date	Days Markt. after Removal at M. S. Date	Date of Failure in Storage	Condition of Failure in Storage
Climax	2d	July 7	July 8	Medium ripe. Excellent quality	7	Aug. 15	Firm, ripened to excellent quality	3–4	Sept. 27	Medium ripe. Flavor old	3	Nov. 26	50% rotten
Climax	3d	July 1	July 4	Soft, few bruised, excellent flavor	0–2	None	Overripe	....	None	....	....	July 23	25% rotten
Climax	3d	July 7	July 8	Soft, few bruised, excellent flavor	4	Aug. 4	Soft ripe. Flavor excellent	3–6	Sept. 3	Soft, flavor fair	3	Nov. 26	60% rotten
Sugar	1st	July 23	July 24	Medium ripe. Very little flavor	8	Sept. 15	Medium to soft. Quality fair	3	Sept. 27	Soft, fair quality	3	Oct. 15	Badly shrivelled and rotting
Sugar	2d	July 23	July 24	Medium ripe. Flavor fair	8	Sept. 3	Medium ripe. Fair quality	3–5	Sept. 15	Soft, fair quality	3	Oct. 15	Badly shrivelled and rotting
Columbia	2d	July 23	July 24	Hard, green-purple color	8	Aug. 14	Medium ripe. Poor quality	3	Sept. 3	Medium ripe. Poor quality	3	Oct. 22	Overripe and rotting
Columbia	3d	July 23	July 24	Firm, green-purple color	8	Aug. 14	Medium ripe. Poor quality	3	Sept. 15	Soft ripe. Poor quality	2	Oct. 22	Overripe and rotting
Sultan (X)	1st	June 25	June 28	Very green, red-green color	15	Sept. 3	Green, poor quality	7	Sept. 27	Green, very poor quality	3–6	Nov. 8	Flesh browned. Badly shrivelled
Sultan (X)	2d	July 7	July 8	Hard, red-green color	14	Sept. 3	Firm, ripened to fair quality	7	Sept. 27	Medium to soft. Fair	3–6	Nov. 26	Very badly shrivelled
Sultan (X)	2d	July 7	July 8	Firm. Green-red color	10	Sept. 3	Medium ripened to good quality	7	Sept. 27	Soft. Good quality	3–5	Nov. 8	50% rotting

Abundance (X)	1st	June 28	June 29	Green	15	Aug. 14	Firm. Very poor quality	7–10	Sept. 3	Firm. Very poor quality	3–6	Nov. 8	Flesh brown. Few rotting
Abundance	2d	July 7	July 8	Firm ripe	14	Sept. 3	Medium ripened to fair quality	3–6	Sept. 27	Soft. Fair quality	3	Nov. 24	Natural breakdown; overripe
Abundance	3d	July 7	July 8	Firm ripe	14	Aug. 4–10	Medium to soft, good quality	3–5	Sept. 3	Soft, good quality	3–5	Nov. 8	Overripe, 60% rotten
Combination (X)	1st	June 25	June 28	Very green	14	Aug. 4	Medium ripe to very poor quality	6	Sept. 27	Firm. Very poor quality	3	Nov. 8	Flesh brown
Combination	2d	July 2	July 4	Medium ripe. Very little color	10	Aug. 14	Medium ripe. Poor quality	7–10	Sept. 15	Medium to soft. poor quality	3	Oct. 22	Flesh brown
Combination	2d	July 2	July 4	Firm ripe. Little color	10	Aug. 4	Medium ripe. Poor quality	3	Sept. 3	Medium ripe. Poor quality	3	Oct. 22	Flesh brown
Combination	3d	July 7	July 8	Medium ripe. Little color	10	Aug. 14	Medium ripe. Poor quality	3–6	Sept. 3	Medium ripe. Poor quality	3	Oct. 22	Flesh brown
Botan	1st	July 11	July 13	Green	10	Aug. 14	Firm, ripened to fair quality	7	Sept. 27	Firm, ripened to very poor quality	3	Nov. 8	Overripe, breakdown
Botan	2d	July 11	July 13	Firm ripe	10	Aug. 14	Firm, ripened to fair quality	7–10	Sept. 27	Soft, ripe, fair quality	3	Nov. 8	Overripe, breakdown
Botan	3d	July 11	July 13	Firm ripe	10	Aug. 14	Firm, ripened to fair quality	7–10	Sept. 3	Soft, poor quality	3	Nov. 8	Overripe, breakdown
Burbank	1st	June 28	June 29	Green	12	Aug. 4–14	Firm to medium ripe. Fair quality	6	Sept. 3	Medium ripe. Quality poor	3–4	Nov. 8	Flesh brown
Burbank	2d	June 28	June 29	Hard ripe	9	Aug. 14	Firm to medium ripe. Fair quality	6–9	Sept. 3	Medium ripe. Quality poor	3	Nov. 8	Flesh brown
Burbank	3d	July 2	July 4	Firm ripe	10	Aug. 14	Medium ripened to good quality	6–10	Sept. 3	Medium ripe. Fair quality	3–4	Nov. 8	Flesh brown and rotting

(X)—Indicates: Picked too green. (XX)—Indicates: Pits split.

TABLE IV—(*Concluded*)

Variety	1st, 2d, or 3d Picking	Date Picked	Date Stored	Condition of Fruit upon Entering Storage	Days Kept Without Storage	Opt. Storage Date	Condition of Fruit at Optimum Storage Date	Days Markt. after Removal O. S. Date	Max. Storage Date	Condition of Fruit at Maximum Storage Date	Days Markt. after Removal at M. S. Date	Date of Failure in Storage	Condition of Failure in Storage
Peach	1st	June 28	June 29	Green	15	Aug. 14	Firm, ripened to very poor quality	6	Sept. 3	Firm, ripened to very poor quality	3	Oct. 22	Rotting
Peach	2d	June 28	June 29	Hard ripe	15	Aug. 4	Firm, ripened to poor quality	3	Sept. 3	Firm, ripened to very poor quality	3	Oct. 15	Rotting
Beauty	1st	June 22	June 24	Hard ripe. Red	7	Aug. 4	Firm, ripened to very good quality	6	Sept. 27	Soft, good quality	6	Nov. 26	Overripe, 30% rotten
Beauty	2d	June 22	June 24	Firm ripe. Dark red	7	Aug. 4	Medium ripened to very good quality	6	Sept. 3	Medium to soft. good quality	3	Sept. 27	Overripe and rotting
Washington	1st	July 11	July 13	Green	10	Aug. 14	Firm, ripened to fair quality	6	Sept. 3	Medium ripe. Fair quality	3	Oct. 22	Flesh brown and overripe
Washington	2d	July 19	July 20	Hard ripe, sour	4	Aug. 4	Firm, ripened to good quality	4	Aug. 14	Medium ripe. Fair quality	3	Oct. 15	Flesh brown and overripe
Washington	2d	July 19	July 20	Hard ripe, sour	4	Aug. 4	Firm, ripened to good quality	4	Sept. 3	Medium ripe. Fair quality	2	Oct. 22	Flesh brown and overripe
Clyman	1st	June 21	June 24	Green	10	July 17	Firm to medium. Ripened to fair	6	Aug. 4	Soft. Very slight wilt. Fair quality	3	Sept. 15	Overripe and rotting
Clyman	2d	June 21	June 24	Green	10	July 17	Medium ripened to very good quality	6	Aug. 4	Soft ripe. Good quality	3	Aug. 17	Overripe and rotting
Clyman	3d	June 30	July 2	Soft, overripe. Flavor excellent	7	July 17	Very soft. Excellent quality	3	Aug. 4	Very soft. Excellent quality	2	Sept. 27	Overripe and rotting

(X)—Indicates: Picked too green. (XX)—Indicates: Pits split.

TABLE V

TABULATED DATA FOR COLD STORAGE OF PLUMS AT 36° F. FOR 1920

Variety	No. of Pick-ings	Date Stored at 36°	Date Market-able without Storage	Date Kept Without Storage	Optimum Storage Date	Condition of Fruit at Optimum Storage	Max. Storage Date	Condition of Fruit at Maximum Storage	Date of Failure in Storage	Condition of Failure in Storage
Kelsey	1	7/20	8/4	8/10	9/5	Green. No flavor	9/30	Hard. No flavor	10/14	Rotting
Kelsey	2	8/4	8/14	8/21	9/15	Med. ripe. Flavor mild. Fair	11/1	Med. ripe. Quality fair	11/29	Rotting
Wickson	1	7/13	7/21	7/29	9/5–15	Firm. Quality poor	9/30	Firm, flavor very poor	11/1	Rotting
Wickson	2	7/13	7/21	7/29	9/5–15	Firm. Quality poor	9/30	Firm ripe. Flavor poor	11/15	Rotting
Wickson	3	7/20	7/23	7/23	9/5	Med. ripe. Quality good	9/15	Soft ripe. Quality good	10/14	Rotting
Agen (French)	1	7/27	8/7	8/10	9/5	Firm. Quality very poor	9/30	Soft ripe. Very poor qual.	11/15	Shrivelled and rotting
Agen (French)	1 (2)	8/11	8/17	8/17	9/15	Med. ripe. Quality poor	9/30	Soft ripe. Poor quality	10/14	20% rotting
Grand Duke	1	7/27	8/10	8/14	9/15	Med. ripe. Quality good	10/14	Soft. Quality fair	11/15	20% rotting
Grand Duke	1 (2)	7/24	8/10	8/17	9/5	Med. ripe. Quality good	9/30	Soft. Quality fair	11/1	20% rotting
Grand Duke	2 (3)	8/4	8/14	8/21	9/5	Med. ripe. Quality good	9/15	Soft ripe. Beginning to rot	11/1	20% rotting
Satsuma	1	7/13	7/23	7/29	9/5	Soft ripe. Quality good	9/30	Soft ripe. Flavor fair	11/1	Rotting
Satsuma	2	7/13	7/23	7/29	9/5	Soft ripe. Quality good	9/15	Soft ripe. Flavor fair	10/14	Rotting
Satsuma	3	7/13	7/23	7/29	9/5	Med. to soft. Quality very good	9/5	Soft ripe. Quality good	9/30	Rotting and flesh browned
German	1	7/29	8/14	8/17	9/5	Med. ripe. Quality poor	9/30	Med. ripe. Quality poor	10/14	20% rotting
German	2	8/11	8/17	8/21	9/5	Med. ripe. Quality fair	9/15	Soft ripe. Quality fair	10/14	30% rotting

TABLE V—(*Continued*)

Variety	No. of Pick-ings	Date Stored at 36°	Date Market-able without Storage	Date Kept Without Storage	Optimum Storage Date	Condition of Fruit at Optimum Storage	Max. Storage Date	Condition of Fruit at Maximum Storage	Date of Failure in Storage	Condition of Failure in Storage
Yellow Egg	1	7/27	8/7	8/10	9/5	Med. ripe. Quality fair	9/15	Soft. Quality fair	11/1	Flesh brown, rotting
Yellow Egg	2	7/29	8/7	8/9	9/5	Soft to Med. Qual. good	9/15	Soft. Quality good	10/14	20% rotten
Yellow Egg	3	8/4	8/7	8/10	9/5	Soft. Quality very good	9/15	Soft. Quality good	11/1	Overripe and rotting
Pond	1	7/27	8/4	8/7	9/5	Firm. Quality poor	9/5	Firm. Quality poor	9/30	Flesh brown
Pond	1 (2)	7/29	8/10	8/17	9/5	Firm. Quality fair	9/30	Med. ripe. Quality fair	11/1	Flesh brown, rotting
Pond	2	8/4	8/14	8/21	9/5	Med. ripe. Quality fair	9/30	Med. ripe. Quality fair	11/1	Flesh brown
Pond	3	8/11	8/14	8/21	9/5	Soft, flavor sweet and good	9/5	Soft, flavor sweet and good	11/1	Rotting
Imperial	1	8/6	8/10	8/10	9/5	Med. ripe. Flavor good	9/15	Soft, flavor sweet and good	11/1	Overripe and rotting
Climax	1	6/24	7/1	7/6	9/5	Soft ripe. Quality good	9/30	Soft ripe. Quality fair	11/15	Rotting and flesh sd. browned
Climax	2	7/4	7/9	7/15	9/5	Med. to soft. Qual. excel'nt	9/15	Soft. Flavor very good	11/1	Shrivelled and rotting
Climax	2	7/13	7/15	7/15	8/17	Soft. Quality excellent	9/5	Quality excellent. Soft	10/14	Few rot. and rest shrivld.
Climax	3	7/4	7/6	7/6	None	Overripe	None	....	8/6	Overripe and rotting
Climax	3	7/14	7/17	7/21	8/6	Soft ripe. Quality excellent	9/5	Soft ripe. Quality fair	9/15	Rotting
Robe de Sargeant	1	7/27	8/7	8/10	9/5	Firm. Little flavor	9/15	Soft. Quality fair	11/1	Rotting
Robe de Sargeant	2	7/29	8/7	8/14	8/17	Firm. Little flavor	9/5	Soft. Quality good	10/14	Rotting
Tragedy	1	7/2	7/12	7/17	8/17	Med. to soft. Quality good	9/5	Soft. Quality very good	11/15	Overripe and rotting
Tragedy	1 (2)	7/2	7/12	7/17	8/17	Med. to soft. Quality good	9/5	Soft. Quality very good	11/15	Overripe and rotting

Tragedy	2	7/13	7/21	7/29	8/17	Med. to soft. Quality excellent	9/5	Soft. Quality excellent	11/1	Overripe and rotting
Tragedy	3	7/13	7/21	7/29	8/17–9/5	Med. to soft. Quality excl.	9/5–15	Soft. Quality excellent	11/1	Overripe and rotting
Sultan	1	6/28	7/9	7/15	8/17	Firm. No flavor	9/5	Med. ripe. Quality very poor	11/15	Badly shrivelled and rotting
Sultan	2	7/14	7/21	7/23	8/17	Med. ripe. Quality good	9/5	Soft. Quality good	10/14	Too soft and rotting
Sultan	2 (3)	7/14	7/17	7/21	8/17	Med. ripe. Quality good	9/5	Soft. Quality good	10/14	Too soft and rotting
Sugar	1 (2)	7/27	8/4	8/7	8/17	Med. ripe. Quality fair	9/5	Soft. Slight wilt. Flavor fair	10/14	Shrivelled and rotting
Sugar	2 (3)	7/27	8/4	8/7	8/17	Med. ripe. Quality fair	9/5	Soft. Flavor fair	10/14	Overripe, rotting
Columbia	2	7/27	8/4	8/7	8/17	Firm to med. ripe. Quality poor	9/5	Medium to soft. Quality fair	9/30	Overripe, rotting
Columbia	3	7/27	8/4	8/7	8/17	Med. ripe. Quality fair	9/5	Soft. Fair quality	9/15	Overripe, rotting
Combination	1	6/28	7/9	7/15	9/5	Med. ripe. Quality very poor	9/15	Soft. Flavor astringent. Very poor	11/1	Flesh brown
Combination	2	7/4	7/12	7/15	8/17	Med. ripe. Quality fair	9/30	Soft. Quality fair	11/15	Flesh brown
Combination	2 (3)	7/4	7/12	7/15	8/17	Med. ripe. Quality fair	9/15	Soft. Quality fair	11/15	Flesh brown
Combination	3	7/14	7/17	7/21	8/6	Med. ripe. Quality fair	9/5	Soft. Quality fair	10/14	Rotting
Beauty	1	6/24	6/26–29	7/1	8/6	Soft. Quality excellent	8/17	Soft. Quality very good	10/15	Overripe. Slight wilt and rot
Beauty	2	6/24	6/26–29	7/1	8/6	Soft. Quality excellent	8/17	Soft. Quality very good	9/30	Overripe and moldy and rotting
Abundance	1	6/29	7/12	7/15	8/17	Med. ripe. Quality poor	9/5	Soft. Quality poor	9/30	Overripe and rotting
Abundance	2	7/14	7/21	7/23	8/6	Med. ripe. Quality fair	8/17	Soft. Quality fair	9/15	Overripe and rotting

TABLE V—(*Concluded*)

Variety	No. of Pick-ings	Date Stored at 36°	Date Market-able without Storage	Date Kept Without Storage	Optimum Storage Date	Condition of Fruit at Optimum Storage	Max. Storage Date	Condition of Fruit at Maximum Storage	Date of Failure in Storage	Condition of Failure in Storage
Abundance	3	7/14	7/21	7/23	8/6	Med. ripe. Quality fair	8/17	Soft. Quality fair	9/15	Overripe and rotting
Botan	1	7/13	7/21	7/26	8/6	Firm. Quality fair	8/17	Firm. Quality fair	9/15	Shrivelled and rotting
Botan	2	7/13	7/21	7/26	8/6	Med. ripe. Quality fair	8/17	Med. ripe. Quality fair	9/15	Shrivelled and rotting
Botan	3	7/13	7/21	7/26	8/6	Med. ripe. Quality fair	8/17	Med. to soft. Qual. fair	9/15	Rotting
Burbank	1	6/29	7/9	7/15	8/6	Firm ripe. Quality poor	8/17	Med. ripe. Quality poor	9/15	Rotting
Burbank	2	6/29	7/6	7/15	8/6	Med. ripe. Quality fair	8/17	Med. ripe. Quality fair	9/15	Rotting
Burbank	3	7/4	7/12	7/17	8/6	Med. to soft. Qual. good	8/17	Soft. Quality good	9/15	Rotting
Peach	1	6/29	7/12	7/21	8/6	Firm ripe. Qual. very poor	8/17	Med. Qual. very poor	9/15	Rotting
Peach	2	6/29	7/12	7/17	8/6	Firm ripe. Qual. very poor	8/17	Med. ripe. Qual. poor	9/15	Rotting
Washington	1	7/13	7/21	7/23	8/6	Firm. Flavor poor	8/17–9/5	Med. to soft. Flavor poor	9/30	Overripe, rotten
Washington	2	7/20	7/23	7/23	8/6	Firm to Med. Flavor fair	8/17	Med. to soft. Flavor poor	9/15	Overripe, rotten
Washington	2 (3)	7/20	7/23	7/23	8/6	Firm to Med. Flavor fair	8/17	Med. to soft. Flavor poor	9/15	Overripe, rotten
Clyman	1	6/24	7/1	7/9	7/13–27	Firm to med. ripe. Quality fair	8/6	Soft. Quality fair	9/5	Overripe and rotting
Clyman	2	6/24	7/1	7/6	7/13–27	Firm to med. ripe. Quality fair	8/6	Soft. Quality good	9/5	Overripe and rotting
Clyman	3	7/2	7/6	7/6	7/13	Very soft. Qual. excellent	7/27	Very soft. Qual. excellent	8/17	Overripe and rotting

TABLE VI

AVERAGE BEHAVIOR OF VARIETIES OF PLUMS AT 32° F. BASED UPON THREE YEARS' OBSERVATIONS (1918–20 INCLUSIVE)

The varieties having the latest optimum storage dates are listed first.

Variety	Years Under Ob-serv.	Average Picking Date	Average Date Mkt. without Cold Storage	Days Mktble. without Cold Storage	Opt. Storage Date	Days Stored to Opt. Storage Date	Days Mkt. after Remo al from Cold Storage at Opt. s. date	Max. Storage Date	Days Stored to Max. Storage Date	Days Mkt. after Removal from Cold Storage at Max. Storage Date
Kelsey	3	Aug. 3	Aug. 17	14	Oct. 8	66	8–12	Nov. 10	99	5
Wickson	2	July 17	July 27	10	Oct. 6	81	7–10	Nov. 5	111	4–7
Grand Duke	3	Aug. 3	Aug. 15–17	12–14	Oct. 5	63	7	Nov. 1	90	5
Satsuma	2	July 13	July 25	12	Sept. 25	74	10	Oct. 20	99	7
Agen (French)	2	Aug. 15	Aug. 24–26	9–11	Sept. 25	41	6	Oct. 19	65	5
Yellow Egg	2	Aug. 3	Aug. 12–14	9–11	Sept. 18	46	6–10	Oct. 10	68	5
Tragedy	3	July 14	July 24	10	Sept. 16	64	7–9	Oct. 10	88	4–6
Imperial	2	Aug. 10	Aug. 16–20	6–10	Sept. 15	36	6–10	Oct. 15	66	3–7
German	2	Aug. 10	Aug. 20–25	10–15	Sept. 12	33	7–9	Oct. 10	61	5
Pond	2	Aug. 10–15	Aug. 15–25	5–10	Sept. 12	28–33	4–8	Oct. 7	53–58	3–5
Robe de Sergeant	2	Aug. 8	Aug. 17–21	9–13	Sept. 10	33	7–10	Oct. 10	63	3–5
Climax	3	July 5	July 14	9	Sept. 8	65	5–8	Oct. 5	92	3–5
Sugar	2	July 29	Aug. 6–8	8–10	Sept. 8	41	5–9	Sept. 27	60	3–5
Sultan	3	July 11	July 21–24	10–13	Aug. 24	44	5–7	Sept. 15	66	3–6
Botan	3	July 14	July 24	10	Aug. 20	37	5–7	Sept. 15	63	3
Columbia	3	July 27	Aug. 4	8	Aug. 15	19	5–7	Sept. 10	45	2–3
Burbank	3	July 8	July 15–18	7–10	Aug. 14	37	4–9	Sept. 3	57	3–6
Abundance	3	July 7	July 17–21	10–14	Aug. 13	37	5–7	Sept. 3	58	3–5
Washington	3	July 20	July 25–29	5–9	Aug. 10	21	4–7	Sept. 3	45	3
Combination	3	July 5	July 15	10	Aug. 10	36	3–6	Sept. 3	60	3
Peach	3	July 9	July 17–20	8–11	Aug. 10	32	6	Aug. 20	43	3–4
Beauty	1	June 22	June 29	7	Aug. 4	43	6	Sept. 15	85	3–6
Clyman	2	June 27	July 6	10	July 30	34	3–6	Aug. 17	42	2–3

TABLE VII

Characteristics of Certain Plums which Affect their Marketability and Keeping Quality in Storage

The varieties are arranged in order of approximate time of ripening, the earlier varieties being listed first.

Variety	Approx. Order of Picking for Exp't.	Average Time of Picking in the Various Plum Sections	Size and Shape	Color of Skin when Ripe	Color and Texture of Flesh	Texture of Skin	Quality	Flavor	Adherence of Stone to Flesh	Juiciness
Beauty	June 22	June 1–10	Medium, heart shape	Brilliant red	Reddish near pit	Moderately tender	Good to very good	Pleasant aromatic		Very juicy
Clyman	June 27	June 3–17	Medium, roundish, flattened	Reddish purple	Greenish yellow to brownish yellow	Tender, sour	Fairly good to good	Somewhat insipid but slightly acid	Nearly freestone	Moderately juicy
Climax	July 5	June 15–July 3	Large, heart shape, cordate or roundish	Dark red, mottled	Yellowish, fibrous, tender	Thick, bitter, tendency to crack	Very good to excellent	Sweet, pleasant, aromatic	Cling	Very juicy
Combination	July 5		Large, roundish	Reddish to carmine red	Pale yellow	Bitter, moderately tender	Fair to good	Mildly sweet	Semi-cling to nearly free	Juicy to very juicy
Burbank	July 8	June 28–July 15	Almost globular, but variable in size, roundish, conic	Spectrum red	Deep yellow, tender but firm	Thin, tough, sour	Good to very good	Sweet, aromatic	Cling	Very juicy
Abundance	July 7	June 6–29	Large, roundish, ovate, slightly compressed, pointed apex	Reddish to amaranth purple	Pale yellow	Moderately tender	Fairly good to good	Sweet, aromatic	Semi-cling to nearly free	Juicy to very juicy
Peach	July 9		Very large, roundish oblate, regular, flattened at ends	Carmine red to purplish red	Firm, crisp, dark greenish yellow at skin to light at pit	Tough, adhering to flesh	Fair to good	Sharply acid to mild	Semi-cling to free	Juicy to very juicy

Sultan	July 11		Medium to large, round	Carmine red to purplish red	Somewhat fibrous	Bitter	Very good	Tendency to be very slightly astringent	Cling	Very juicy
Satsuma	July 13	July 25–Aug. 5	Fruit averages 2¼ in. in dia., roundish, cordate to somewhat oblate; large	Magenta to black purple	Purplish, tender at skin, tough at pit	Medium thickness and toughness, bitter	Very good	Sweet almond-like flavor	Semi-cling to cling	Juicy
Botan	July 14	June 6-29	Medium, globular	Light to yellow	Greenish brown to yellow		Fair to good	Flat and insipid	Cling	Rather dry to juicy
Tragedy	July 14	June 10–July 1	Medium to large, oblong	Purplish black Venetian blue	Green	Tough	Good to very good	Mild, subacid	Cling to semi-cling	Juicy
Wickson	July 17	July 10-25	Very large, heart shape	Reddish to carmine red	Green near skin to amber at pit	Tender	Good to very good	Sweet aromatic	Freestone	Very juicy
Washington	July 20	July 25–Aug. 5	Very large, roundish oval, compressed	Greenish yellow	Greenish yellow, soft, mushy	Moderately tough	Good	Somewhat acid but insipid	Nearly free	Somewhat dry to fairly juicy
Columbia	July 27		Very large, nearly globular, one side slightly larger	Magenta to purple	Green to light, green at pit	Tough	Fair	Flat, subacid, somewhat astringent	Clingstone	Somewhat dry to fairly juicy
Sugar	July 29	July 20–Aug. 5	Large, oval	Reddish	Golden yellow, fibrous, tender	Thin, tender	Good to very good	Sweet	Freestone	Juicy
Grand Duke	Aug. 3	Aug. 1–20	Very large, oval, necked	Dark purple	Green to amber	Tender and acid	Good	Sweet and mildly subacid	Semi-cling to nearly free	Fairly juicy

TABLE VII—(*Concluded*)

Variety	Approx. Order of Picking for Exp't.	Average Time of Picking in the Various Plum Sections	Size and Shape	Color of Skin when Ripe	Color and Texture of Flesh	Texture of Skin	Quality	Flavor	Adherence of Stone to Flesh	Juiciness
Kelsey	Aug. 3	July 20–Aug. 10	Very large, heart shaped, with a distinct suture	Reddish	Green, amber at pit	Moderately tender	Fairly good to good	Sweet, aromatic	Clingstone to semi-cling	Fairly juicy to juicy
Yellow Egg	Aug. 3	July 20–Aug. 10	Very large, long oval necked	Greenish yellow	Yellow, tender	Tough	Good to very good	Sweet, sub-acid	Freestone	Juicy
Robe de Sergeant	Aug. 8		Medium size, oval	Blackish purple	Greenish yellow		Good to very good	Sweet	Semi-cling	Juicy
German	Aug. 10		Long oval, slightly swollen in the ventral side	Dark purple	Greenish yellow, firm	Tough, separates readily from skin	Fair to good	Mild to pleasant	Freestone	Dry to fairly juicy
Imperial (Epineuse)	Aug. 10		Uniformly large, oval	Purple	Greenish yellow, fibrous, tender	Thin	Good to very good	Sweet, agreeable	Clingstone	Juicy
Pond (Hungarian)	Aug. 10–15	Aug. 5–20	Very large, obovate or oval, slightly necked	Reddish	Yellow, soft, tender	Tough, astringent	Good	Sweetish, sub-acid around pit	Clingstone	Juicy
Agen (French)	Aug. 15		Medium, ovate	Magenta purple	Greenish, fibrous, tender	Thin, tough	Very good	Sweet, pleasant	Variable	Very juicy

Of the three varieties, the Kelsey kept latest in storage, but proved the lowest in quality. It is, however, of large size and commands good prices. The Wickson and the Grand Duke are both excellent dessert fruits and retain their quality in storage. The Wickson will keep a greater number of days than either the Kelsey or the Grand Duke. It will not keep quite so late, owing to the fact that it is harvested about two weeks earlier. Both the Kelsey and the Grand Duke are harvested fairly late in the season, the Kelsey from the last week of July to the first week in August, and the Grand Duke from the first to the middle of August. If properly grown in a section where the normal ripening period is comparatively late, picked at the correct stage of ripeness, hurried into cold storage at temperatures of about 31° to 32° F., and carefully handled, the Kelsey might be kept for the Thanksgiving trade. Under the conditions stated, this variety should be marketable about four days after removal from storage.

(2) *Very good keeping plums.*—Satsuma, Agen (French Prune), Yellow Egg, and Tragedy can be kept in cold storage for a considerable period of time and relatively late in the season. All these varieties are of high quality, and retain their flavor and texture while in storage. These varieties kept in excellent market condition until the last week of September or the first week in October and upon removal from storage they remained marketable for a week to ten days. (Tables IV and VI.)

The Satsuma and the Tragedy kept the greatest number of days, but not long enough for the late market because their harvest period is mid-season. The Yellow Egg and the French are harvested fairly late in the season, so that it was possible to keep them in cold storage relatively late.

(3) *Moderately good keeping plums.*—Imperial, German Prune, Pond, Robe de Sergeant, Climax, Sultan, and Sugar kept until the middle of September. The Pond kept late in the season only because it is one of the latest plums to be harvested. This is also true, to a somewhat less degree, of the German, Robe de Sergeant, Imperial, and Sugar. The Climax, however, ripens early, yet kept nearly as late in the season as Pond, German, Imperial and Robe de Sergeant, and slightly later than Sugar. This is also true of the Sultan, which ripens about one week later than the Climax.

(4) *Inferior keeping plums.*—The Beauty, Botan, Abundance, Burbank, Combination, Clyman, Peach, Washington, and Columbia did not keep well. Of these varieties the Beauty kept best and retained

its quality with the least deterioration. It is, however, the earliest plum tested, and therefore, did not keep late in the season.

The Abundance, Burbank, Combination, and Clyman kept fairly well at 32° F. for about four to five weeks, but all failed in storage before the normal season of the late plums was over.

The Washington and the Columbia proved to be unsuitable for storage. They rapidly lost quality and soon spoiled.

It should be borne in mind that for most varieties the data are based upon only two to three years' work and that the keeping qualities of the same variety of plum vary with the season, soil, and cultural treatment. Further work is therefore contemplated. Nevertheless, the keeping dates are at least approximately correct, and should give the relative value of the varieties tested for cold storage purposes. The varieties which kept longest in cold storage are those that the growers have found to withstand handling and transportation best. (Tables IV to VI.)

The average dates of harvesting and of keeping without cold storage, and the optimum and maximum storage periods, are shown in Chart II.

Type of failure in storage.—The manner in which the different varieties of plums failed in storage (Tables IV and V) is important.

(*a*) The Tragedy, Grand Duke, Yellow Egg, German, Robe de Sergeant, Imperial, Columbia, Botan, Agen (French), Sugar, and Beauty, ripened well in cold storage, but of course more slowly than at room temperature. These varieties, if stored when fairly mature, became too soft for ordinary marketing before rot or physiological breakdown made them unfit for use.

(*b*) The Kelsey, Wickson, Pond, Sultan, Combination, Burbank, Peach, and Washington, broke down internally, probably physiologically, before they became over-ripe in storage. The flesh remained firm but became discolored and dry, and lost its flavor and aroma.

(*c*) The Climax, Abundance, and Satsuma broke down physiologically before becoming over-ripe in storage when stored too green. If sufficiently developed when picked, they attained good quality, and ripened normally.

(*d*) Those varieties which were inclined to wilt and shrivel and in this way give evidence of having been picked too green were the Satsuma, Grand Duke, Sugar, and Sultan.

Temperature of storage for plums.—A study of the tabulated data for 32° F. and 36° F. (Tables IV and V) will show that the lower temperature is preferable. The fruit held at 32° F. kept one to three weeks longer than that held at 36° F. The difference in favor of the

32° F. temperature was more marked in the case of the later ripening, longer keeping varieties. The varieties which had a short storage period did not show much difference in their behavior at 32° F. and 36° F., probably because of the fact that during the relatively short time, the difference in temperature could not exert a very marked influence.

During the 1919 season the varieties were kept at both 32° F. and 30° F., but since they did not keep appreciably better at one temperature than the other, the data from the 30° F. room are not presented. Certain varieties, particularly the Washington, experienced considerable freezing at 30° F. and the evidence indicates, therefore, that 32° F. is the safer and more satisfactory temperature for the storage of plums.

The behavior of the fruit at a temperature of 36° F. is of especial interest at this time, in connection with the possibility of shipping plums by boat through the Panama Canal, since the temperature which would be maintained under refrigeration by such boats would more closely approximate 36° F. than 32° F.

Four to five weeks should be ample time for the trip to be made and the fruit to be marketed. The results as shown in Table V indicate that the varieties which kept at a temperature of 36° F. for five weeks and remained marketable for from seven to ten days include the following: Kelsey, Wickson, French, Grand Duke, and Satsuma. Similarly, a list of varieties which kept about four weeks is as follows: Yellow Egg, Pond, Climax, Tragedy, Robe de Sergeant, and Beauty; and a list of plums with a shipping period, under such conditions, of about three weeks includes the following varieties: German, Imperial, Sultan, and Combination. The varieties which kept at a temperature of 36° F. from two to three weeks, and which therefore appeared unsuited for such shipments are Sugar, Columbia, Abundance, Botan, Burbank, and Peach. The Washington and the Clyman, at 36° F., kept only about two weeks, and could not, therefore, be shipped by way of the Panama Canal to the eastern coast markets.

Degree of maturity for picking.—Ramsey[5] during the season of 1913 endeavored to determine the proper stage of maturity at which Italian prunes should be picked for fresh-fruit shipment, when grown under the conditions of the Willamette Valley, Oregon. Three pickings one week apart were made, the first picking about three weeks before the time that the fruit is normally harvested for evaporation or drying. He found no considerable increase in size between the first and the last picking, except in one instance. The fruit from the first picking had an excellent flavor at the end of the longest storage period for that fruit, while the fruit from the last picking was almost unfit to eat, although its appearance was very good.

The lack of increase in size, as well as the unfavorable behavior of the last picking in storage, can perhaps be accounted for by the fact that all the pickings were made relatively late for fresh-fruit shipment. Prunes when harvested for drying, at a time coinciding with Ramsey's third picking, are practically dead ripe. The first picking referred to by Ramsey would therefore correspond closely with the second or third picking in these experiments.

In the past, California growers have centered their attention mostly on the early eastern market. This has been done in order to avoid competition with the later crop in other sections of the country. The fruit has been picked fairly green so as to enable it to reach the eastern markets just before attaining its edible condition. Domestic or European varieties are not, as a rule, picked quite so green as the Triflora or Japanese plums.

Observations and experience of both fruit growers and cold-storage men emphasize the fact that the degree of maturity which fruit has attained when picked exerts a profound influence upon its keeping in cold storage and upon the quality developed.

There are available only one year's data on plums to determine the effect of maturity upon the two characters mentioned above. During the 1920 season (Tables IV and V) the fruit was picked at three different stages of maturity. The first picking was made four to eleven days in advance of the second, which was made about the time the main bulk of the fruit was harvested, or at the time the variety was picked commercially. The third picking was made four to eleven days after the second.

The proper stage of ripeness for picking is difficult to determine and with most varieties of plums is relatively short. Nevertheless, the work for one year brings out several interesting points. For example, the Tragedy can be picked relatively green (the first picking, 1920) and ripen to good quality and hold up nicely in storage (Table IV). The second lot, however, picked eleven days later, attained somewhat better quality, and still held up nicely in storage. The period during which the Tragedy can be picked is therefore relatively long. Nevertheless the somewhat larger size and better quality of the second picking made it preferable for storing. The third picking did not keep quite so well in storage (Chart III). The Wickson and the Climax may be picked fairly immature, but are better when permitted to remain on the trees until more mature.

Practically all the other varieties, but notably the Combination, Abundance, Burbank, and Peach, did not attain good quality unless they were fairly well matured when picked. The data indicate that the harvesting period for these varieties is limited to not over four or five days. When picked green, they did not attain good quality and wilted or shriveled, while if picked too ripe, they did not keep in storage.

As previously mentioned, the second picking in these experiments was made at the time which was considered best for commercial purposes in the Sacramento Valley (Table VII). The data show clearly that it would be unwise to pick the fruit any earlier than the average commercial picking. This is shown by Chart III, illustrating the behavior of the Agen (French Prune) when stored. The first picking did not keep so late in storage and neither did the fruit hold up so long after removal from storage as did the second picking. This was also true of the Kelsey, as shown by Chart IV.

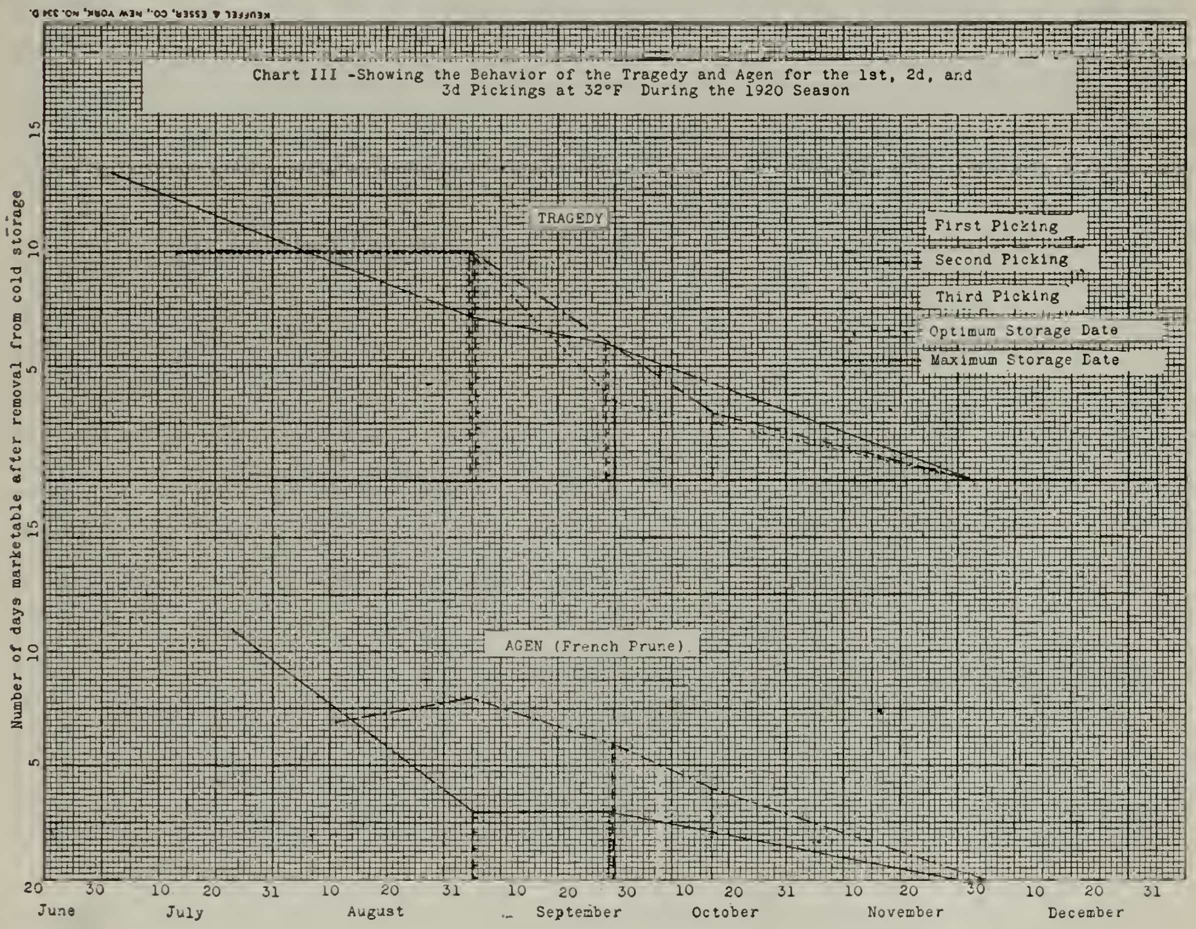


Chart III -Showing the Behavior of the Tragedy and Agen for the 1st, 2d, and 3d Pickings at 32°F During the 1920 Season

Furthermore, the fruit of the third picking taken from four to ten days after the second picking attained much better quality upon ripening than did the fruit of the first and second pickings. The striking fact is that the later or third picking of fruit held up about as well in storage as did the fruit of the first and second picking.

This is indicated by Charts III and V, showing the behavior of the three pickings at 32° F. for the varieties Satsuma, Tragedy, and Wickson. The exceptions to this behavior were the Climax (Chart IV), Clyman, and Pond. With these varieties, the third picking proved too ripe.

The data therefore indicate that, in most cases, plums are picked too green for shipping. If they are allowed to remain on the trees two or three days longer, under lower Sacramento Valley conditions, it would seem that the quality, appearance, and flavor will be much improved. Furthermore, if the fruit is handled carefully and quickly placed in storage, when it is to be retained or precooled or brought down to refrigerator car temperatures and is shipped east, the keeping qualities would not be appreciably impaired as a result of the later picking.

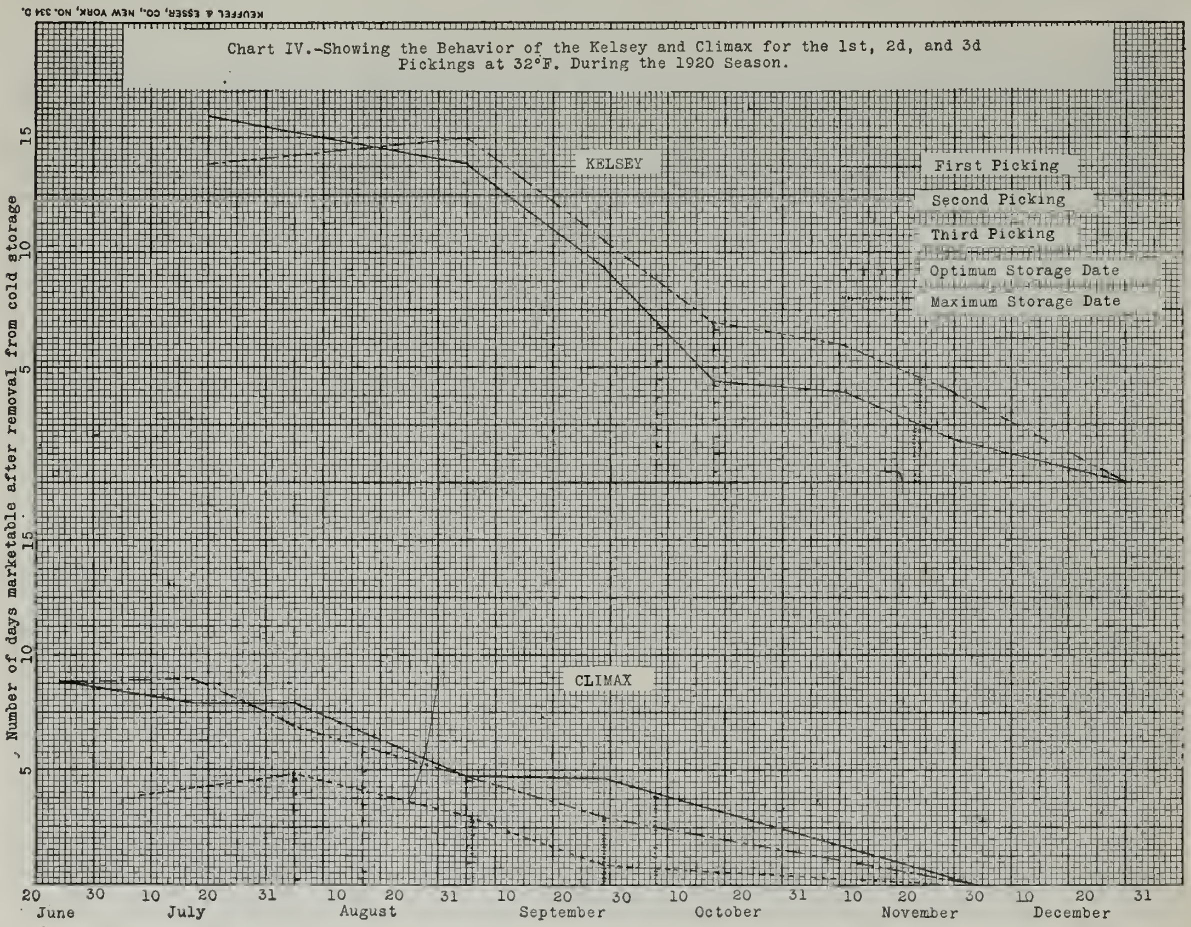


Chart IV.-Showing the Behavior of the Kelsey and Climax for the 1st, 2d, and 3d Pickings at 32°F. During the 1920 Season.

PRACTICAL APPLICATION OF RESULTS

Plums are perishable and, with the risk of loss involved, there would be no justification for storing them unless the returns from this practice compensated for the cost and risk.

It is interesting in this connection to refer to Chart VI, which shows graphically the average daily prices received for all varieties of plums upon the New York City market, and the influence of the total number of crates received each day upon the price for the shipping season of 1920. The price is highest at the beginning of the season, when the receipts are lowest, and then drops until the lowest point is reached as the maximum quantity of plums reaches the market. As the receipts fall off at the close of the season, the price for certain varieties of plums may rise, so long as the quality remains good. It is interesting to note the constancy of the opposite directions taken by the quantity curve, as shown by the solid line, and the price, indicated by the broken line. The high points in the receipt curve are found to occur simultaneously with the low points on the price curve, and vice versa.

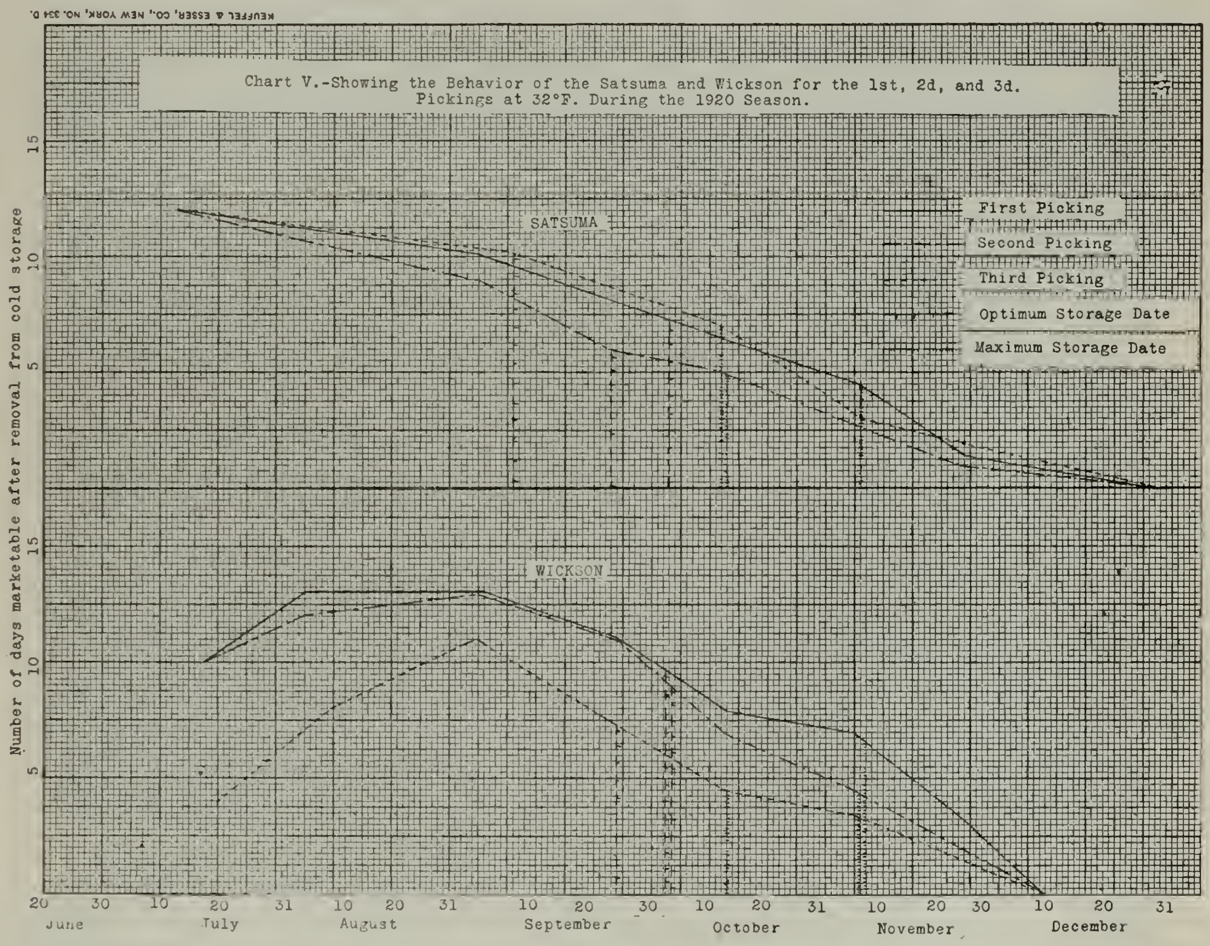


Chart V.-Showing the Behavior of the Satsuma and Wickson for the 1st, 2d, and 3d. Pickings at 32°F. During the 1920 Season.

This indicates that on days when the market receipts were exceptionally heavy, it would pay to store temporarily the surplus plums until the over-supplied market became more normal. This would be particularly true if it were possible to know the probable new receipts of the plums upon the market during the period following the time of evident over-supply. For example, on the seventeenth of August, with a total receipt of 6930 crates, the average price being paid for plums per crate was $2.66; on the nineteenth, with the receipt of 5835 crates, the price per crate was $2.83; and on the following day with the receipt of only 170 crates, the average price paid per crate was $4.37. There was a difference of $1.54 a crate between the two successive days resulting from differences in supply.

The relatively high price that prevailed from about the twentieth to the twenty-fifth of August during the season of 1920 (Chart VI) can perhaps be explained by referring to Chart VII. The dates mentioned cover a period between the close of the main bulk of plum shipments from California and the beginning of the shipments from

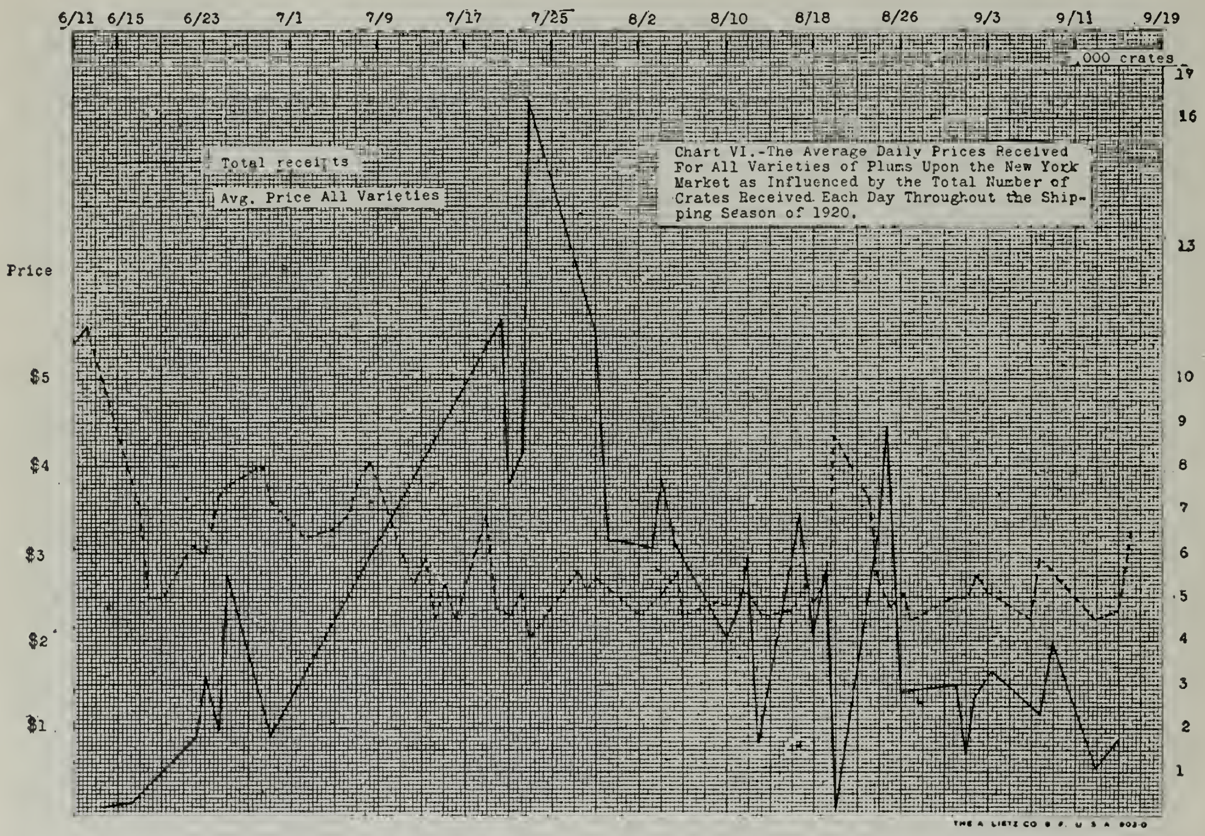


Chart VI.-The Average Daily Prices Received For All Varieties of Plums Upon the New York Market as Influenced by the Total Number of Crates Received Each Day Throughout the Shipping Season of 1920.

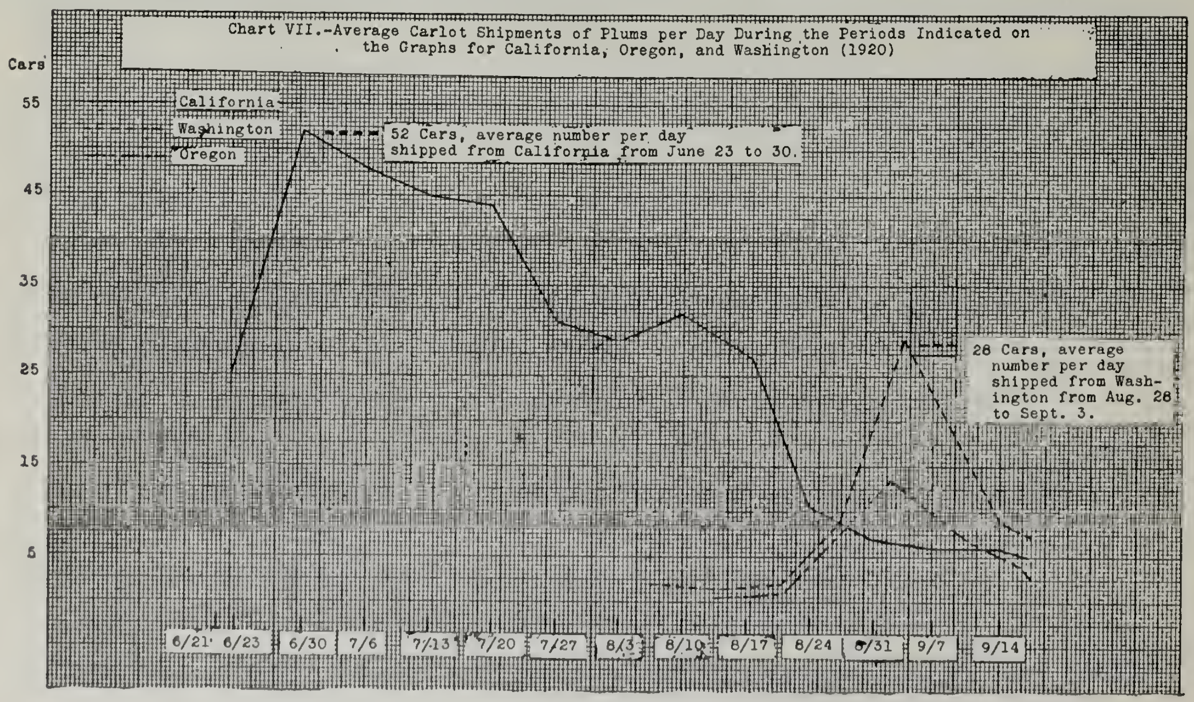


Chart VII.-Average Carlot Shipments of Plums per Day During the Periods Indicated on the Graphs for California, Oregon, and Washington (1920)

52 Cars, average number per day shipped from California from June 23 to 30.

28 Cars, average number per day shipped from Washington from Aug. 26 to Sept. 3.

Washington and Oregon, and shipments were therefore at a minimum. In years when such a situation exists it would appear feasible and profitable to store California plums with the idea of keeping the demand properly supplied during this period.

Storage of early plums.—Since the price of a variety of plum is influenced not only by the available quantity of that variety, but also by the total available quantity of all varieties, it would perhaps seldom be advisable to store the early varieties. Early in the season there are not many varieties of plums on the market and the prices are high. A study of Charts VIII and IX, in which are plotted the prices and

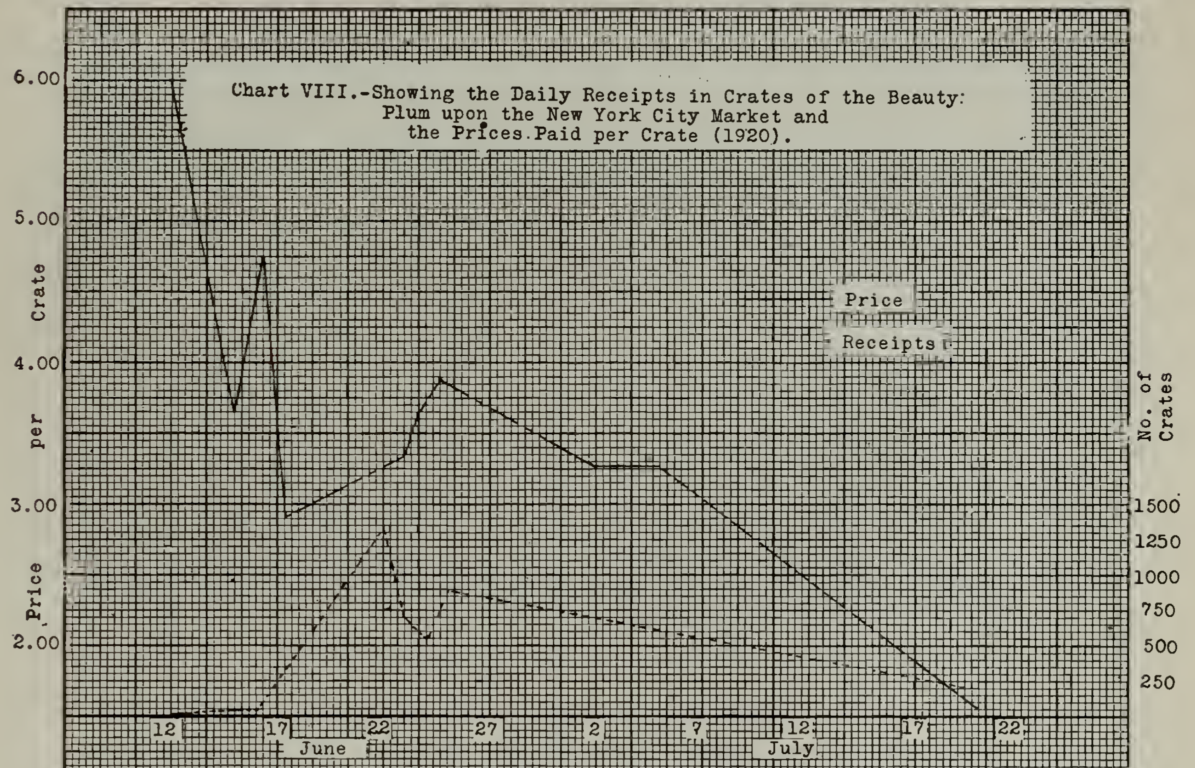


Chart VIII.-Showing the Daily Receipts in Crates of the Beauty Plum upon the New York City Market and the Prices Paid per Crate (1920).

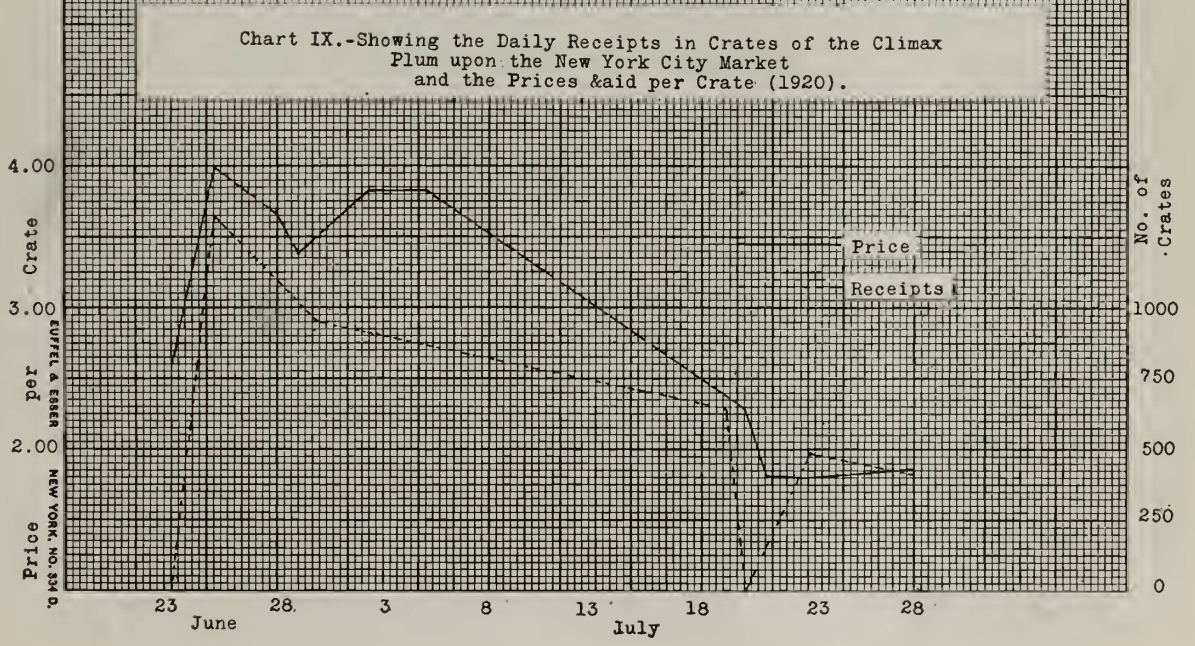


Chart IX.-Showing the Daily Receipts in Crates of the Climax Plum upon the New York City Market and the Prices &aid per Crate (1920).

number of crates upon the New York City markets for the two leading early plums, the Beauty and the Climax, shows that with the early plums the prices continue to fall, even though the quantity of these varieties diminishes. This is because of the increasing heavier receipts of other vareties of plums.

Storage of late plums.—By reference to Chart VII and Table VIII it may be seen that the shipments of plums from California in 1920 were largest between June 21 and August 17, the week of maximum shipment being June 23 to June 30. It is interesting to note that the peak in receipts was reached in New York City July 23. By the time most of the other states had begun to ship, the California shipments had practically ceased. The other states (Table VIII) ship in large quantity from the last of August until the first week of October. Hence the market is over-supplied during this period, and the result is a large and sudden drop in prices. The receipt of California plums in New York City shows a marked decrease after the first week in September, and by the middle of September the quantity generally becomes so small that plums are dropped from the list of arrivals and only prunes are recorded.*

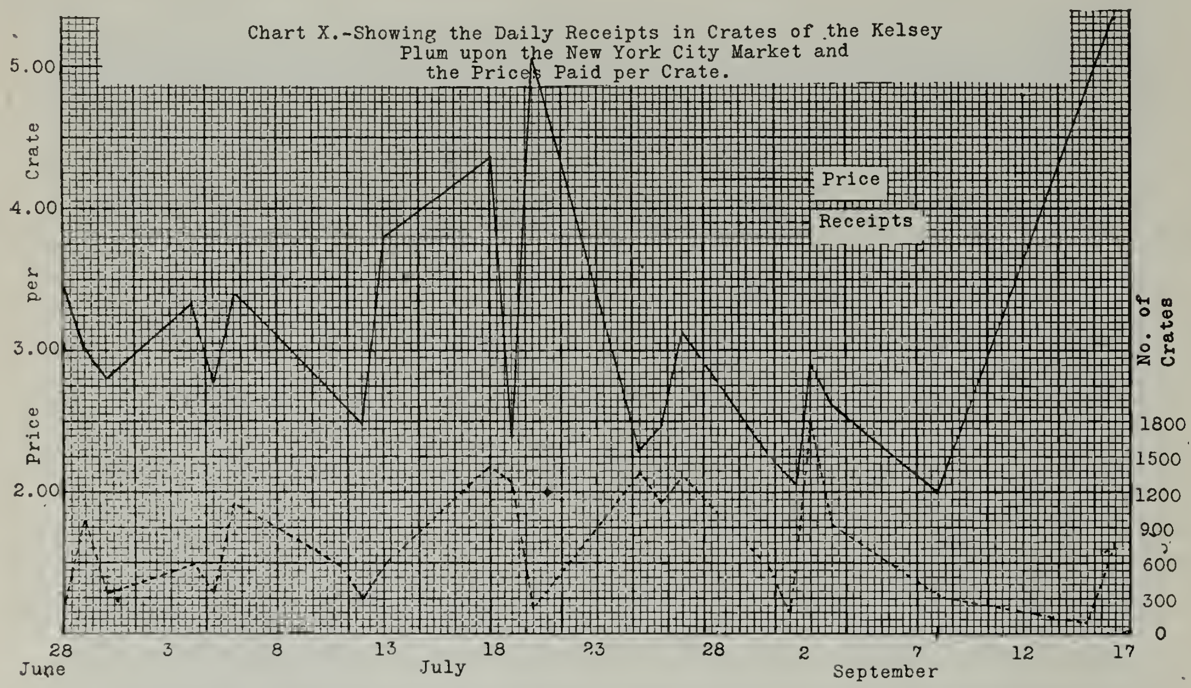


Chart X.-Showing the Daily Receipts in Crates of the Kelsey Plum upon the New York City Market and the Prices Paid per Crate.

In 1919 the largest number of car lot shipments including all states were made in August (Table VIII); in 1920 larger shipments were made in September. The shipments made during October were relatively light and confined to the early part of the month. Hence there is a period shortly after the first week of October when fresh plums and prunes become scarce upon the market. Therefore, California plums which had been stored would have to be disposed of between the period following the end of the shipments from California and the beginning of the shipments from other states or be retained until after the later shipments from other states had ceased. If the latter were to be successfully done, sufficiently higher prices to justify the practice might be obtained. The risk, however, is comparatively great, and fruits such as pears and apples would come into competition.

---

* Journal of Commerce of New York City, Sept. 7, 1920.

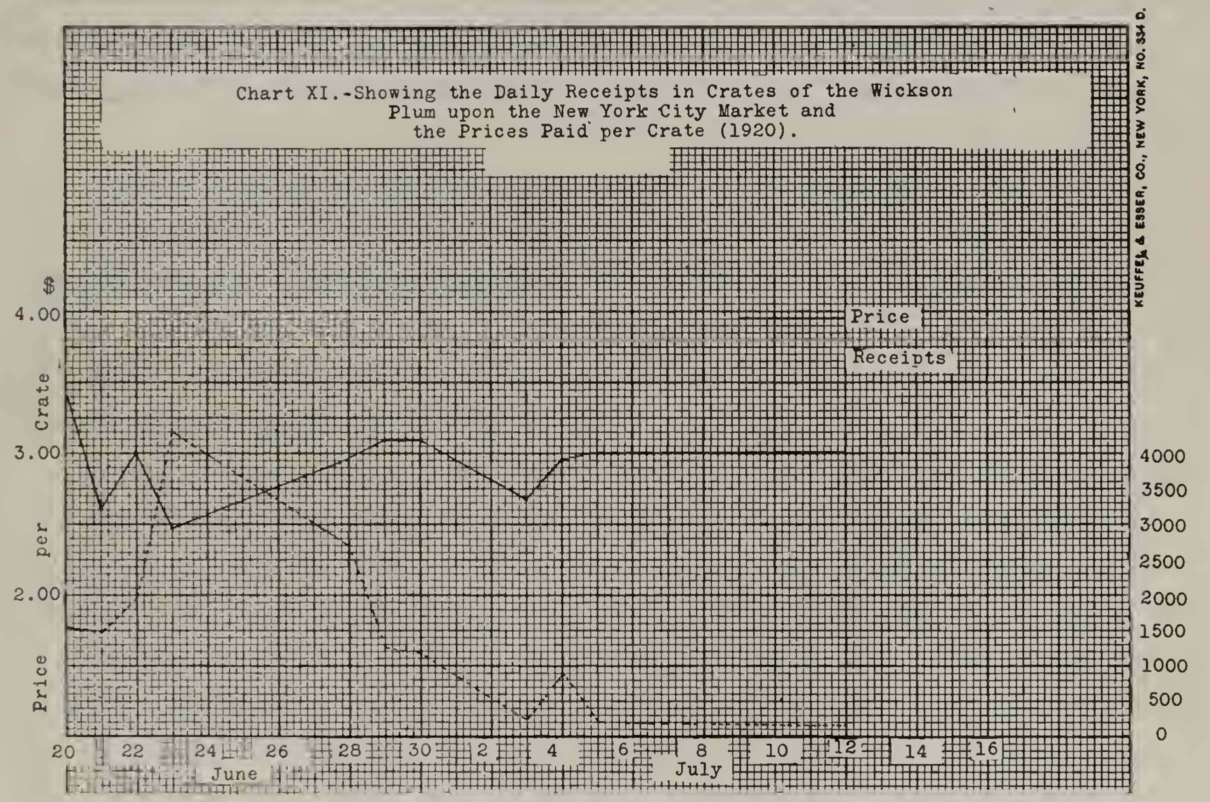


Chart XI.-Showing the Daily Receipts in Crates of the Wickson Plum upon the New York City Market and the Prices Paid per Crate (1920).

TABLE VIII

SHOWING THE CAR LOT SHIPMENT OF PLUMS AND FRESH PRUNES BY MONTHS
(From the *Market Reporter,* 1920.)

	1920				1919					
States	June	July	Aug.	Sept.	June	July	Aug.	Sept.	Oct.	Total
California	303	670	280	10	584	901	440	9	....	1934
Idaho	......	......	......	1047	......	......	......	233	72	305
Michigan	......	......	18	160	......	......	39	34	....	73
New York	......	......	123	538	......	......	26	23	4	53
Oregon	......	......	73	92	......	......	305	93	32	430
Pennsylvania ..	......	......	......	56	......	......	......	11	....	11
Washington	......	......	126	209	......	......	297	92	2	391
Others	......	......	2	10	......	......	1	7	19	27
Total	303	670	622	2122	584	901	1108	502	129	3224

In the case of a desirable late variety, such as the Kelsey, the plums shipped at the last part of its normal shipping season bring higher prices than the first shipments (Chart X). This is due to the fact that there are not only fewer Kelsey plums, but also much smaller quantities of other varieties (Charts VI, VII, and X). This is also true to a less extent of the Wickson, which is a mid-season plum, but which has a long shipping period. In addition to the fact that there are fewer Wicksons, the later shipments therefore have smaller quantities of other varieties with which to compete. Hence the price, as shown by Chart XI, rises and continues to remain at a higher level than that exhibited throughout most of the other portion of its shipping period. It would therefore appear that under some conditions it might be profitable to prolong the season for plums by storing such varieties as the Kelsey, which might be disposed of at a sufficient profit during the late fall months to justify the cost of storage.

The early plums yield the biggest profits in an early district, but not in a late one, since, as a rule, they are inferior to later varieties in size and quality. Furthermore, the early varieties in a late district have to compete with the later varieties from early districts. Hence it will not pay to store late varieties in an early district. The cold storage of plums with the view of prolonging the season can be best done by a late district with its late varieties.

Precautions necessary previous to storage.—Ramsey[5] has given suggestions applicable to the picking, handling, and shipping of plums which are to be stored. The utmost care in picking must be exercised to avoid bruising the fruit in placing it in the picking receptacle, in transferring it to the orchard box, and in hauling it to the packing house. (1) Do not rub off the bloom; (2) grasp the fruits by the pedicel or stem and lay one at a time in the picking receptacle; (3) do not drop or violently roll the fruit from one container to another; (4) keep the fruit in the shade or protected from the sun after it is harvested; (5) in packing, cull out all imperfect or cracked fruits; (6) when possible, pack and grade directly from the lug box, which lessens the number of times the fruit is handled; (7) precool promptly and thoroughly, and keep chilled until stored, or store at 32° F. as soon as possible. The careful observance of these suggestions is necessary for the successful shipment of plums, either by rail under refrigeration, or by boat through the Panama Canal.

ACKNOWLEDGMENTS

The writers thanks and appreciation are extended to Mr. H. E. Jacobs, who assisted during the season of 1920 and helped in summarizing the data; to Mr. G. L. Philp and Professor F. W. Allen, who harvested the fruit and, in most cases, prepared it for shipment; to Dr. J. C. Whitten, who furnished kindly counsel and suggestions, and to Mr. A. J. Winkler and Mr. L. P. Latimer, who prepared the charts.

SUMMARY AND CONCLUSIONS

1. The Wickson had an optimum storage period of nearly twelve weeks and remained marketable for a week to ten days after removal. Its maximum storage period was nearly sixteen weeks and, upon removal, it ripened to fair quality and remained marketable for from four to seven days.

2. The optimum storage period for the Satsuma was almost eleven weeks and it was marketable after removal for from seven to ten days. The maximum storage period of this variety was about fourteen weeks, after which it remained marketable for from six to seven days.

3. The Kelsey could be kept later because its season of ripening was not so early as that of the Satsuma and the Wickson. Its optimum storage period was about ten weeks, with a marketable period of nearly ten days. The maximum time in storage averaged fourteen weeks, and after removal it remained marketable for about five days. The quality attained by this variety at both the optimum and maximum storage periods was only fair.

4. The Climax, Tragedy, and Grand Duke also have long keeping periods. Their optimum storage is about nine weeks, with a period of marketability of eight to ten days, and the maximum storage period is nearly thirteen weeks, with a period of marketability of from five to seven days. The Grand Duke ripens comparatively late and hence might be employed to extend somewhat the season for fresh plums. The Tragedy and especially the Climax ripen so early in the season that, despite their long keeping qualities, they cannot be profitably employed for this purpose. The Tragedy retains its good quality in storage exceptionally well. The Climax is excellent to eat at the optimum storage, but only attains fair dessert quality at the maximum. The Grand Duke at best is only of fair quality and remains so throughout its entire storage period.

5. The Yellow Egg, Sultan, Beauty, Agen (French), and Sugar fall together in another group. Their optimum storage period is somewhat over six weeks and they are marketable after removal at this time for from five to eight days. The maximum storage time is about nine weeks, with the exception of the Beauty which can be kept satisfactorily for nearly twelve weeks. Upon removal at the maximum period these varieties remain marketable only for from three to five days.

6. The Botan, Abundance, Burbank, Imperial, Combination, Clyman, Robe de Sergeant, German, Pond, and Peach have an optimum

storage period of from four to five weeks and remain marketable for about five days. The maximum period averages from seven to nine weeks, except for the Peach and the Clyman, which cannot be kept more than six weeks and then remain marketable for only two or three days. Even the others are marketable for only about three to five days. Of the varieties just mentioned, the Imperial and Robe de Sergeant keep the longest.

7. The Washington and the Columbia deteriorate very rapidly in storage and their optimum does not exceed two to three weeks.

8. Among the plums tested for storage, the Climax and the Tragedy develop the highest quality. On the other hand, the Combination, Peach, Botan, Columbia, and German are all of low quality.

9. The most desirable temperature for the storage of plums appears to be 32° F.

10. There are, however, certain varieties of plums which keep well at 36° F. and which when properly picked and handled can be expected to hold up sufficiently well to be shipped by refrigerator boats through the Panama Canal to eastern coast markets. These varieties are: Kelsey, Wickson, Agen (French), Grand Duke, Satsuma, Yellow Egg, Pond, Climax, Tragedy, Robe de Sergeant, and Beauty. In addition, four other varieties may be suggested, although their keeping period at 36° F. is a week to ten days less, i.e., German, Imperial, Sultan, and Combination. These last-named plums, however, will be marketable in eastern markets for only a relatively short period after removal from storage.

11. Varieties of plums which appear to be unsuited for shipment east by boat, because of their poor keeping qualities at 36° F., are Sugar, Columbia, Abundance, Botan, Burbank, Peach, Washington, and Clyman.

12. Studies of shipments of plums to the New York markets emphasize the fact that when the receipts are large the prices are low. It would therefore seldom pay to store the early plums. It might pay for men who know the markets to store temporarily, during a period when the markets are over-supplied, certain mid-season varieties, such as the Satsuma, Tragedy, and Wickson. The Kelsey and possibly also the Wickson might, under favorable conditions, be profitably stored two to three months in order to extend the plum season. They could then be placed upon the market after the plums from other later shipping states were off the market.

13. The relative importance of the varieties of plums, as indicated by the amounts received upon the New York City markets during the season of 1920, is as follows: Kelsey, Pond (Gross, Hungarian), Wickson, Tragedy, Giant, Grand Duke, Diamond, Burbank, Climax, Beauty, American Blue, Clyman, Sugar, President, Gaviota, Santa Rosa, California Blue, Formosa, Purple Duane, German, Yellow Egg, and Apex.

14. There is evidence that most of the shipping plums are frequently picked too green. Two or three days longer upon the tree does not appreciably shorten their storage period and does result in larger size, and better color and flavor.

15. When plums are to be shipped any distance or to be stored any length of time, it is imperative to employ the greatest care in picking, grading, packing, and handling the fruit.

BIBLIOGRAPHY

[1] BIGELOW, GORE, HOWARD: Studies on Apples. U. S. Bureau of Chemistry, Bull. 94 (1905).

[2] BUISON: ''De 'Lemploi de froid dans la conservation des fruits.'' L'Industrie frigorifique, p. 165 (1912).

[3] GORE: Studies on Fruit Respiration. U. S. Bureau of Chemistry, Bull. 142 (1911).

[4] HAWKINS, L. A., and SANDO, C. E.: Effect of Temperature on the Resistance to Wounding of Certain Small Fruit and Cherries. U. S. D. A., Bull. No. 830, pp. 1–6 (1920).

[5] RAMSEY, H. J.: The Handling and Shipping of Fresh Cherries and Prunes from the Willamette Valley. U. S. D. A., Bull. No. 331, pp. 1–28 (1916).

STATION PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

BULLETINS

No.
185. Report of Progress in Cereal Investigations.
241. Vine Pruning in California, Part I.
246. Vine Pruning in California, Part II.
251. Utilization of the Nitrogen and Organic Matter in Septic and Imhoff Tank Sludges.
253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California.
261. Melaxuma of the Walnut, "Juglans regia."
262. Citrus Diseases of Florida and Cuba Compared with Those of California.
263. Size Grades for Ripe Olives.
266. A Spotting of Citrus Fruits Due to the Action of Oil Liberated from the Rind.
267. Experiments with Stocks for Citrus.
268. Growing and Grafting Olive Seedlings.
270. A Comparison of Annual Cropping, Biennial Cropping, and Green Manures on the Yield of Wheat.
271. Feeding Dairy Calves in California.
273. Preliminary Report on Kearney Vineyard Experimental Drain.
275. The Cultivation of Belladonna in California.
276. The Pomegranate.
278. Grain Sorghums.
279. Irrigation of Rice in California.
280. Irrigation of Alfalfa in the Sacramento Valley.
282. Trials with California Silage Crops for Dairy Cows.
283. The Olive Insects of California.
285. The Milk Goat in California.
286. Commercial Fertilizers.
287. Vinegar from Waste Fruits.
294. Bean Culture in California.
297. The Almond in California.
298. Seedless Raisin Grapes.
299. The Use of Lumber on California Farms.
300. Commercial Fertilizers.
304. A Study on the Effects of Freezes on Citrus in California.

No.
308. I. Fumigation with Liquid Hydrocyanic Acid. II. Physical and Chemical Properties of Liquid Hydrocyanic Acid.
309. I. The Carob in California. II. Nutritive Value of the Carob Bean.
310. Plum Pollination.
312. Mariout Barley.
313. Pruning Young Deciduous Fruit Trees.
316. The Kaki or Oriental Persimmon.
317. Selections of Stocks in Citrus Propagation.
318. The Effects of Alkali on Citrus Trees.
320. Control of the Coyote in California.
321. Commercial Production of Grape Syrup.
323. Heavy vs. Light Grain Feeding for Dairy Cows.
324. Storage of Perishable Fruit at Freezing Temperatures.
325. Rice Irrigation Measurements and Experiments in Sacramento Valley, 1914-1919.
328. Prune Growing in California.
329. A White Fir Volume Table.
330. Dehydration of Fruits.
331. Phylloxera-Resistant Stocks.
332. Walnut Culture in California.
333. Some Factors Affecting the Quality of Ripe Olives.
334. Preliminary Volume Tables for Second-Growth Redwoods.
335. Cocoanut Meal as a Feed for Dairy Cows and Other Livestock.
336. The Preparation of Nicotine Dust as an Insecticide.
337. Some Factors of Dehydrater Efficiency.
338. Selection and Treatment of Waters for Spraying Purposes.
339. The Relative Cost of Making Logs from Small and Large Timber.
340. Control of the Pocket Gopher in California.
341. Studies on Irrigation of Citrus Groves.
342. Hog Feeding Experiments.

CIRCULARS

No.
70. Observations on the Status of Corn Growing in California.
82. The Common Ground Squirrels of California.
87. Alfalfa.
110. Green Manuring in California.
111. The Use of Lime and Gypsum on California Soils.
113. Correspondence Courses in Agriculture.
115. Grafting Vinifera Vineyards.
126. Spraying for the Grape Leaf Hopper.
127. House Fumigation.
128. Insecticide Formulas.
129. The Control of Citrus Insects.
130. Cabbage Growing in California.
138. The Silo in California Agriculture.
144. Oidium or Powdery Mildew of the Vine.
148. "Lungworms."
151. Feeding and Management of Hogs.
152. Some Observations on the Bulk Handling of Grain in California.
153. Announcement of the California State Dairy Cow Competition, 1916-18.
154. Irrigation Practice in Growing Small Fruits in California.
155. Bovine Tuberculosis.
157. Control of the Pear Scab.
158. Home and Farm Canning.
159. Agriculture in the Imperial Valley.

No.
160. Lettuce Growing in California.
161. Potatoes in California.
164. Small Fruit Culture in California.
165. Fundamentals of Sugar Beet Culture under California Conditions.
166. The County Farm Bureau.
167. Feeding Stuffs of Minor Importance.
169. The 1918 Grain Crop.
170. Fertilizing California Soils for the 1918 Crop.
172. Wheat Culture.
173. The Construction of the Wood-Hoop Silo.
174. Farm Drainage Methods.
175. Progress Report on the Marketing and Distribution of Milk.
178. The Packing of Apples in California.
179. Factors of Importance in Producing Milk of Low Bacterial Count.
181. Control of the California Ground Squirrel.
182. Extending the Area of Irrigated Wheat in California for 1918.
183. Infectious Abortion in Cows.
184. A Flock of Sheep on the Farm.
188. Lambing Sheds.
189. Winter Forage Crops.
190. Agriculture Clubs in California.
193. A Study of Farm Labor in California.
198. Syrup from Sweet Sorghum.
201. Helpful Hints to Hog Raisers.